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THE DENVER N. E. L. A. CONVENTION.

As will be seen from the telegraphic report, printed elsewhere, of the first sessions of the Denver Convention of the National Electric Light Association, the meeting gives every promise of being one of the most interesting in the history of that body. Naturally, the subject of the new metallic filament lamp came up for discussion, and the brief account which we are enabled to give indicates that central station men do not fear the situation which its commercial perfection would create. Mr. Dunham, of Hartford, who perhaps holds the record in this country among central station men for progressiveness in adopting new central station material, predicted that the industry would recover very quickly from any effect of reduction in demand of current caused by the use on circuits of high-efficiency lamps, and another member expressed the belief that a higher efficiency lamp would mean a greater demand for electric light, thus eventually redounding to the benefit of the central station. It was also pointed out that the probable effect of the introduction of a high-efficiency lamp would, as in the case of the mantle gas burner, act as a stimulant in increasing demand for light. The commercial side of the question was also considered by Dr. Bell in a paper, an abstract of which will be found on page 1089. Should the metallic filament lamp commercially realize its present promise, one effect of its adoption would perhaps be to raise the standard incandescent lamp candle-power rating from 16 to about 22 candles. In view of the fact that gas jets are now rated at from 22 to 25 cp., and gas mantles at from 40 to 80 cp, such an increase in the electric light unit would seem to be along proper lines, aside from the advantage the increase would have in meeting the central station financial situation brought about by the use of a lamp of much higher efficiency than the present carbon filament lamp.

UNIFORMITY OF INSURANCE INSPECTION.

Elsewhere we print an account of the organization of the Western Association of Electrical Inspectors, to which body we tender a hearty welcome, joined with the hope that it is the forerunner of similar organizations that eventually will cover every section of the country. We have had occasion to point out the handicap suffered by the National Electrical Code through the diversity of interpretation of its rules by inspectors in different parts of the country. The discontent among electrical people fostered by this condition has been steadily growing, and has lately threatened to lead to a movement toward rupturing the amicable relation which for some years has existed between the underwriting interests and the various electrical bodies meeting with its representatives in annual conference on the subject of the code. Associations of the kind just organized at Chicago will contribute powerfully to remove this danger and they will, moreover, be qualified to offer valuable suggestions as to changes in or additions to the code.

It is noteworthy that about three-quarters of the membership of the new association consists of municipal inspectors, which is an indication of the present extent of municipal electrical inspection. It cannot be denied that excellent work is being done by the municipal inspection bureaus of some cities. The fact appears to be, however, that the underwriters have fostered municipal electrical inspection, and have brought influence to bear toward the creation

of city bureaus, and also toward securing their efficient administration when established. The motive for this is far from an altruistic one, the object being to saddle off on the municipality work which the underwriters should, in the judgment of fire risks, assume as part of the expense incident to their business. As long as the underwriters and municipal bureaus co-operate harmoniously, perhaps little harm is done, though a double control of a kind as drastic as that which the conditions of fire inspection involve, is apt to bear hard on those subject to it. However, whether the inspection be by the underwriters or by city inspectors, or by both, it is important that it be thorough, just and uniform to all, and organizations of the kind just formed in Chicago will tend to bring about this condition.

MEASURING THE SLIP OF INDUCTION MOTORS.

The article in this issue, on page 1076, by Mr. F. Lawton Stone, describes a mechanical method of measuring the slip in induction motors, which seem particularly well adapted to workshop conditions and may be a rival of electrical or stroboscopic laboratory methods. The speed counter applied to the induction motor contains a little synchronous motor and a nest of differential gearing, so arranged that when in operation the speed counter will only record the difference between the revolutions of the synchronous machine and the revolutions of the induction motor. This difference in speed, divided by the synchronous speed, gives the slip. The precision of the apparatus is of the same order as that of the ordinary speed counter. Moreover, the instrument does the counting and relieves the observer of all observational responsibility except the timing by stop-watch. A still further development of this mechanical method should be capable of indicating the slip, upon a graduated scale, from moment to moment, thus eliminating the delay and possible error involved in the timing of the application.

There are so many properties of the induction motor which depend upon the slip that no test of such a machine can be searchingly made without means for properly determining the slip. The ordinary method is an optical or stroboscopic method, with the aid of an alternating-current arc lamp operated from the main circuit. This is particularly well adapted to very small slips. As pointed out in the article, however, the optical method is ill adapted for the measurement of fairly rapid slips. Moreover, it is a laboratory method, rather than a factory method, since it calls for special apparatus and a darkened room. We recently called attention to an electrical method for measuring the slip which involved a contact maker on the induction motor shaft, and a circuit through the contact maker and a voltmeter, from the main line. The fluctuations of the voltmeter readings enable the speed of slip to be observed with the aid of a stop-watch. Here again the apparatus is well designed to indicate very small slips. When the slip attains a certain magnitude, the pulsations of the voltmeter needle would probably be difficult to count with certainty. Moreover, the necessity for the application of a contact maker to the shaft of the induction motor is sufficient to deter many persons from attempting the use of this method. The ideal apparatus for factory use would be a simple and reliable mechanical apparatus which would be capable of direct application without loss of time to any induction motor, and which would indicate the percentage of slip by a dead-beat needle upon a graduated scale. This would be akin to the operation of determining the speed of any dynamo machine by the tachometer. Meanwhile, the apparatus described in the article appears to be a distinct step in the desired direction.

INFLUENCE OF IONIZING BODIES UPON THE SPARKING DISTANCE BETWEEN ELECTRODES IN AIR.

A recent article on this subject has appeared in the *Elektrotechnische Zeitschrift*, as alluded to in our Digest columns. The effect of developing either positive or negative ions, from an extraneous source, in the vicinity of the electrodes in a spark-gap is studied experimentally, with a view to ascertaining the conditions that determine sparking distance between opposed points in air. Some interesting conclusions are reached in this way. It is generally admitted that the curve connecting sparking distance as ordinates with voltages as abscissæ is a straight line; but it is not considered to be a straight line through the origin. In other words, the voltage has to reach a certain value before there is any sparking distance, and then after this critical voltage has been passed, equal steps in ascending voltage produce equal steps in increasing spark length. The results indicated that the curve is not greatly altered by the presence in the neighborhood of incandescent or burning substantes. The liberation of positive ions in the vicinity of the anode had very little influence, but in the vicinity of the cathode they enabled the sparking distance to be increased. The liberation of negative ions in the vicinity of the anode reduced the sparking distance; but in the vicinity of the cathode had very little influence. The effect of increasing the number of free negative ions at the anode was to produce a surface resistance to spark discharge.

The article seeks to explain the above phenomenon by the layer of negative ions which will adhere to the plate when the latter is positive, and so increase the resistance at the surface; whereas when the point is positive, on account of the increased electric density on a point, a layer of negative ions cannot so readily be maintained. If we suppose that the sparking voltage is that which will produce the critical velocity in negative ions, permitting them to attain a momentum capable of disrupting neutral atoms at successive collisions, then it is conceivable that a layer of negative ions in close proximity to the positive electrode might be held there with considerable force, and that the ions in this layer might require an extra high electric gradient in order to dislodge them. Much more experimental material will probably have to be accumulated before the complete explanation of the spark discharge in gases can be obtained. The experimental results are complicated by so many variables that the effect of each variable alone is obscured. We have varying densities, pressures, temperatures, substances at the electrodes and gradients of potential. The most hopeful method of inquiry should be one in which only one of these variables is rendered capable of successive modification.

THE MEASUREMENT OF SMALL ALTERNATING CURRENTS.

It is surprising how imperfect is the apparatus for the measurement of alternating currents from the standpoint of the laboratory. We have alternating-current ammeters capable of measuring currents for engineering purposes with a satisfactory degree of accuracy, but when we require to calibrate such instruments carefully in the laboratory, there is often considerable difficulty. We have two principles in general use for such purposes, namely, the electrodynamometer principle and the hot wire principle. In the electrodynamometer the mutual electromagnetic forces between two coils are made to produce rotation of one of them against an opposing couple of definitely known and adjustable strength. In the hot wire instruments the expansion of a wire heated by the alternating current can be compared with that due to a direct current of the same strength. In an article appearing on page 1077, Dr. Frederick Bedell gives an account

of an apparatus operating on different lines. It is known that the carbon filaments of incandescent lamps reduce their resistance greatly as the current strength through them increases. Moreover, such filaments have quite negligible inductance, so that with altenating currents, the influence of inductance upon the apparent resistance of the filaments is quite inappreciable. If, therefore, the alternating current to be measured is passed through the lamp, and its corresponding reduction in resistance can be determined, the strength of the alternating current can be ascertained by finding the corresponding strength of continuous current that will produce the same reduction in resistance.

The particular method employed by Dr. Bedell for measuring the resistance of the lamp under test is theoretically very interesting. He arranges four similar lamps in a Wheatstone bridge or quadrilateral, sends the alternating current through the system between one pair of opposite corners, and the testing current through the other pair, at right angles thereto. If the four lamps maintain equal resistances at all stages of the process, the application of the resistance measuring apparatus will not alter anything in the alternating-current distribution, provided that the testing current strength is relatively so feeble as not to add appreciably to the heating of the filaments already raised in temperature by the alternating current. The calibration curve of the lamps as given in the article is very interesting. The change in resistance is evidently very small below 3 milliamperes of traversing current, but it steadily increases, until it becomes about half an ohm per milliampere. This sensitiveness is fairly well maintained between 15 and 33 milliamperes range. The curve, as drawn, seems to be almost identical with a hyperbola about the axis of resistance, with a focus at 128.8 ohms, a directrix through 135.6 ohms and an eccentricity of 1.63. If, however, the scale of milliamperes were the same as the scale of ohms, the observations, after being replotted, would practically coincide with another hyperbola, having the same center, at 142.7 ohms, but with its directrix through 136.4 ohms and its focus at 121.3 ohms, with an eccentricity of 1.84. The meaning to be attached to this remarkable relation seems to be that a simple quadratic equation substantially connects the resistance of the lamp filament with the traversing current strength within the limits here presented; but this is perhaps in its turn the result of some more fundamental physical relation not immediately apparent. Owing to the difficulty of securing four lamp filaments that will maintain precisely equal resistances at all temperatures, it would seem that special precautions would be necessary in making the measurements, in order to guard against errors due to inequalities in the lamp resistances, and the admission thereby of a spurious difference of potential into the measuring circuit.

HIGH-VOLTAGE GENERATORS.

At the present moment the generator seems to be a bit behind the game in the general march of electrical improvement. If one wanted a few years ago to establish a power transmission plant, he found available generators wound for the highest pressures then regarded as at all conservative. If he chose he could, of course, use a low-voltage generator with raising transformers, but the added expense was a somewhat serious matter. This ability to get successful high-voltage generators was really due to the general adoption of revolving-field generators in place of the time-honored type with revolving armatures. That improvement having been made, the generator was allowed to rest on its laurels, and for nearly a decade very few improvements have been made in generator design or construction, save in the matter of economizing material, often at the expense of more important matters. The improvement has been almost wholly in the interest of cheapness, and while the user of apparatus has to a certain extent been allowed to share in the benefits, he has upon the whole little to be thankful for. We have been having in this country an era of standardization which is always a time of suspended growth in the very nature of things. We have seen some machines turned out as standard in the last two or three years that had been cheapened until their regulation was simply scandalous.

But this aside. The question we want here to ask is, Why in the present state of the art is it not possible to produce high-voltage generators with perhaps oil-insulated armatures, capable of giving directly from their terminals any voltage that is now used for transmission? We hear the answering wail of specialization, but specialization is the only road to improvement. The gain in simplicity would be considerable, and the abolition of the transformers certainly should accomplish saving enough to far more than compensate for the extra cost of construction, just as has already come to pass with 10,000-volt generators. Probably the high-voltage generator with extra space for insulation and perhaps extra exciting current might lose a trifle in efficiency, but that it would be likely to lose the 2½ per cent or so now lost in transformers seems very improbable indeed. With oil-insulated generators directly coupled to water wheels, preferably with vertical shaft in this case, and passing to the lines with a minimum of switchboard complication, a generating station would be somewhere near to simplicity. And simplicity is now become a painfully rare virtue in generating stations. It has actually come to the pass where in some cases the auxiliary apparatus costs about as much as the generators, and where one must look for probable trouble not in the machines, but in the maze of wiring, switches and instruments that gives an architectural effect to an interior otherwise severely simple. Of course, objections are easy to raise, danger of lightning being one of the old standby arguments against high-voltage generation. But the fact is that high-voltage transformers are anything but cheap lightning arresters. They cost no inconsiderable fraction of the value of the generators themselves.

The central station to-day has reached a truly frightful degree of complexity, chiefly from a species of megalomania that has claimed victims among engineers and promoters of late. There is no honor or glory whatever from our point of view in possessing the biggest generating station in the world, or the most elaborately specialized switchboard, or the most complete automatic system of avoiding the dangers to which these peculiarities expose one. The best station is the one that gives the best service for the least money, be it big or little, entangled with auxiliaries like the conning tower of a battleship, or almost bare of them. The greater uses of electricity must come through the more general utilization of natural forces, and the watchwords of success here are economy and simplicity. There are very many hydraulic powers which to-day are practically useless, but which are almost within the possibility of economical development. With a comparatively short extension of the practical radius of transmission they could be utilized with good results. To cut down costs even a little means no inconsiderable extension of market. The line cost can be reduced by the successful insulation of higher and higher voltages. When 40,000 volts is as common a working pressure as 10,000 volts is now, the average charge against the line will be greatly reduced. If in addition the raising transformer could become a thing only necessary when by its use the compensating advantage of 75,000 or 100,000 volts could be gained, the electrical costs might be fairly regarded as modest. At present, rise of working voltage is going on more slowly than for a long time past. The insulator is just now the thing most needing improvement, but the generator needs pushing forward also, and the sooner engineers get about it the better. If the greater projects in transmission are to come to fruition it must be by improvements all along the line, and the advance should not be delayed.

National Electric Light Convention.

(By Telegraph.)

The experiment of the National Electric Light Association in making the long trip to Denver promises to be a great success. It is the first time the body has been so far West and the outcome thus far is most gratifying. Already the convention takes high rank in the roll of the thirty N. E. L. A. meetings, in attendance, in number and excellence of the papers, in discussions and in exhibits.

Delegates began to arrive last week, but the largest contingent came in on Monday, when two special trains over the Pennsylvania and Burlington routes discharged heavy loads during the afternoon. The first special train came direct from New York and carried about 125 passengers. It left Saturday morning from Jersey City, picking up parties at Philadelphia and Pittsburg, and reached Denver twelve minutes ahead of time, in spite of a tropical thunder storm and fierce heat. A halt of about two hours was made in Chicago on Sunday morning, which was devoted to sight seeing, the train leaving Chicago soon after eleven. The second section of the special Chicago, Burlington & Quincy train was made up in Chicago with about 100 from that region. It was in charge of Mr. Frank L. Perry, and followed the New York section closely into Denver. In spite of hot weather the trip was made pleasantly and on time. The train itself was one of the finest ever sent out of Chicago. The dining car, which was the one exhibited at the St. Louis Fair, and was used on this train for the first time, excited especially the admiration of even the most blasé old-timers. It is finished in Flemish oak, the windows are leaded and the ventilators are of stained glass. Electric lights are enclosed in iron lanterns of artistic design. The furniture is in Flemish oak and leather and the general effect is that of a country club with ever-changing scenery outside the windows. Mr. George Porter was master of transportation in charge of all arrangements.

The Denver Gas & Electric and local committees are doing the limit in hospitalities and courtesies. Messrs. Doherty, Tripp, Frueauff, Farrar, Brady and Hammond boarded the trains in the early morning when miles out to arrange for baggage and hotel accommodations. Most of the delegates are at the Brown Palace, but beautiful and sunny Denver is a city of good hotels, and the visitors are comfortably located all over the city.

The public courtesies began with a reception and dance at the Brown on Monday night, which was crowded, and the enjoyment was kept up until midnight. Tuesday afternoon the ladies were given a drive and luncheon at the Country Club. In the evening all the convention went as a theatre party to the Elitch Summer Gardens to see a comic opera and other shows, and for Wednesday afternoon a broncho-busting contest is to take place in one of the parks. In spite of such distractions the members are attending to business and the sessions are well attended. The number registered by Tuesday morning was about 1,000, and others were still arriving.

Mayor Speer, of Denver, welcomed the convention on Tuesday morning in an address highly laudatory of Colorado and Denver, which was received with prolonged applause. President Davis, in his presidential address, said that the choice of meeting place this year was a tribute to the great development of central stations throughout the West, and intended to bring Eastern and Western central station men into closer touch. Referring to legislation, he said that vital central station interests were constantly being menaced by proposed enactments. Commissions like that of Massachusetts do not lack good features, but the association should be active in this connection and make suggestions when laws regulating companies come up in various States. The laws of various States should conform to some uniform standard. The appointment of a standing legislative committee was recommended. State associations should be encouraged and municipal ownership should be discouraged by low rates and evidence from municipal plants showing their real status. President Davis announced that the Association of Licensed Manufacturers of Incandescent Lamps had appropriated $10,000 to co-operate with central stations in increasing the use of incandescent lamps. He outlined plans for the expenditure of this money and recommended the appointment of a committee to further the object.

Mr. T. C. Martin then presented his "Progress Report" and also read the paper by Dr. Louis Bell on the "Tantalum Lamp," abstracts of both of which will be found elsewhere. In connection with the latter paper, a number of tantalum lamps were exhibited in circuit. The subject of the new lamp gave rise to much interest. Mr. Arthur Williams, of New York, thought the tantalum lamp would be too expensive to affect the industry appreciably, and that it had not been long enough in the United States to make intelligent discussion of it possible. Mr. J. F. Gilchrist, of Chicago, brought up advisability in view of the advent of the tantalum lamp, of selling current on a lamp-hour instead of kilowatt-hour basis. Mr. Dunham, of Hartford, said that the industry would recover very quickly from the effect of reduction in demand for current caused by the high efficiency of the tantalum lamp. Mr. Farrand, of Boston, took the broad view that a higher efficiency lamp meant greater demand for electric light, which would soon lead to better net results for the industry. He thought it would be impossible to secure tantalum lamps fast enough to cause any reduction in receipts for current. Mr. Gardner, of Boston, compared the probable effect of the introduction of the tantalum lamp with that of the mantle gas burner, which latter acted as stimulant to electric lighting.

The paper by Mr. David Hall, of the Bullock Company, entitled "The Paramount Importance of Choosing Standard in Preference to Special Machinery," was then read. An abstract of this paper is printed elsewhere. In the discussion Mr. McCabe said manufacturers ought to get together and agree on standard speeds and sizes. Mr. Hartman, of Philadelphia, pointed out that the great variety of engine speeds was partly responsible for lack of standards. Mr. C. E. Skinner, of the Westinghouse Company, then read his paper, abstracted elsewhere, on "Insulation Testing, Apparatus and Methods," after which the session adjourned.

The first paper presented at the afternoon session of Tuesday was that of Mr. Louis E. Bogen, of the Bullock Company, entitled "Notes on Rotary Converters and Motor-Generator Sets." In the discussion Mr. Renshaw expressed the opinion that 600-volt, 60-cycle rotaries are entirely feasible. Mr. Alex. Dow thought that for railway sub-stations rotary converters even of 60 cycles are best and cheapest, but for electric light sub-stations motor-generators are cheaper and more reliable because of the cost and complication of auxiliary voltage and speed regulating apparatus for rotaries. Mr. Arthur Williams, of New York, reopened the discussion on the "Progress Report" of T. C. Martin. Workmen liked the mercury vapor lamp when they became accustomed to its light. Refrigeration gives a station load which does not come on during winter peaks. He cited figures showing that electric refrigeration with current at 5 cents per kw-hour is cheaper than ice at $3.00 per ton. Electric signs, he said, are now established means of advertising. Mr. Alex. Dow replied to questions about the Detroit plant, mentioned in the "Progress Report." He explained Detroit conditions, mainly as given in an article in these columns last winter. Mr. W. P. Hancock, of Boston, read his paper entitled "The Organization of Working Forces in Large Power Houses," abstracted elsewhere, which started some discussion on handling labor organizations. Mr. Dunham, of Hartford, said he gave employes a dividend last year. Mr. W. C. L. Eglin presented the report of the Committee on Steam Turbines and the session concluded with the reading of the paper

by Mr. A. H. Kruesi, of the General Electric Company, entitled "Operating Features of the Curtis Steam Turbine," an abstract of which will be found elsewhere in this issue.

The session of Wednesday morning was opened by the reading of the paper by Mr. Clarence Renshaw, of the Westinghouse Company, entitled "Series Alternating-Current Motors for Industrial Work," which was followed by the paper by S. Percy Cole, of the Wagner Company, on "A New Type of Single-Phase Motor for Elevator Work."

After a short discussion on these papers, Mr. Alex. Dow presented the report of the Committee on Present Methods of Protection from Lightning and Other Discharges, which he supplemented by recommending a single grounded wire for lightning at the center of the three-phase pole triangle, for very high voltages. The report was followed by an interesting discussion. Mr. R. F. Hayward, of Salt Lake City, said that much trouble had been experienced from lightning on the Utah transmission system, which covers a district 140 miles long, all operated in parallel. The lines are affected by almost every storm that occurs. He believed protective devices must be spread out instead of being localized, as lightning will not travel far. He expects to try a grounded wire on poles, and has tried with success grounding one circuit on a two-circuit pole line. He does not believe in a grounded line between transmission wires. Mr. E. P. Dillon, of Colorado Springs, related difficulties encountered at foot hills; lightning is less troublesome at very high altitudes. Messrs. Jackson, Hennold and Hartman also discussed the report.

Mr. E. P. Roberts, of the Nernst Lamp Company, then read his paper on "The Nernst Lamp." Mr. Arthur Williams, of New York, spoke of extensive application of three- and six-glower Nernst lamps in replacing mantle gas burners. The cost of maintenance and renewals of Nernst lamps was one cent per kw-hour. Mr. Dunham, of the Hartford Electric Light Company, said that his company had in use 3500 glowers. In order to secure high efficiency and to prevent the possibility of the heaters burning out the glowers are renewed after 450 hours of service. The meeting then adjourned until the evening.

No fewer than 139 operating companies are represented. Sixty-three of these are Eastern and remainder are largely from the Far West, California being well in evidence. Even with the restrictions placed upon new members, the Association includes to-day 502 lighting companies, of which about 150 are located west of the Mississippi. Colorado is in the lead, owing to the active work of Messrs. Doherty and Tripp, as shown by the fact that this State has one member to 24,000 inhabitants, while Pennsylvania has but one to 160,000. The indications of this convention are that the present year will see a notable growth in membership. The local press has been very helpful, and has given extended notices with cartoons of all the prominent men.

Appointment of P. R. R. Electric Traction Engineer.

Mr. Geo. Gibbs on June 1 resigned as vice-president of Westinghouse, Church, Kerr & Company, and as consulting engineer of the Interborough Rapid Transit Company, of New York, to become chief engineer of electric traction of the terminal operation of the Pennsylvania Railroad in New York, and chief engineer of electric traction of the Long Island Railroad. In these positions Mr. Gibbs will have charge of all the electrical engineering and the design and execution of work in connection with the Pennsylvania Railroad's tunnels, yards, terminals, power houses, etc., as well as the design and installation of all electric traction work which the Long Island Company has in contemplation. The work thus put into his hands constitutes the largest electric traction project on any steam railroad in the world. In addition to all this, Mr. Gibbs has accepted the position of consulting engineer of the Metropolitan Street Railway Company, of New York, for the proposed subway work.

Mr. Gibbs is best known through his work in connection with the present subway lines in New York, in which he took a very prominent part as engineer in charge of the rolling stock and block signal system. To Mr. Gibbs, more than to anyone else, is due the credit of installing the steel cars in the subway. These cars were the first steel passenger cars in the world, and were largely of Mr. Gibbs' design. Another of his notable achievements was that of applying in the subway, and for the first time in this country, the over-lapping block-signal system. Mr. Gibbs was graduated from the Stevens Institute of Technology in 1882, with the degree of mechanical engineer. From 1882 to 1884 he was engaged as chemist for the Orford Copper Company, and from the latter date to 1888 was engineer of tests and chemist of the Chicago, Milwaukee & St. Paul Railway Company, Milwaukee, Wis. From 1888 to 1897 he was mechanical engineer of this company. In this position he had charge of all car and locomotive design for the road, as well as of its interlocking and track signals. From 1897 to 1902 he was consulting engineer of the Baldwin Locomotive Works, and of the Westinghouse Electric & Manufacturing Company, also chief engineer of the British Westinghouse Electric & Manufacturing Company, Ltd., and of the Continental Westinghouse companies.

Since 1901 Mr. Gibbs has been first vice-president of Westinghouse, Church, Kerr & Company, of New York, consulting engineer of the Interborough Rapid Transit Company, of New York, member of the board of engineers of the Pennsylvania Railroad Company's New York tunnel lines and terminals, member of the Electric Traction Commission of the New York Central & Hudson River Railroad Company's New York terminal and electric traction lines, and electrical engineer of the Long Island Railroad Company's lines which are being converted to electricity. In the positions enumerated he had charge of the following work: For the Interborough Company, design of rolling stock, track work, interlocking and signals, shop yards and repair plants, and, in consultation, other railway facilities of the company; for the Pennsylvania Railroad in his capacity as member of the company's board of engineers to carry on this work; special charge of the company's electrical power plants, electrical locomotives, power distribution system, and mechanical engineering features of the terminal yards and buildings; for the New York Central Railroad, its electric traction work, including the equipment of its heavy electric locomotives, power plants and distributing system. Mr. Gibbs has also acted as confidential adviser in engineering of the Carnegie Institute, Washington, D. C. He is a member of the American Society of Civil Engineers, British Institution of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Railway Master Mechanics' Association and the Master Car Builders' Association.

Austrian Tests of the Tantalum Lamp.

Our Austrian contemporary, the *Zeitschrift fur Elektrotechnic*, prints an account of tests made on the tantalum lamps by Herr Egon Siedek, of Vienna. Pressures as high as 200 volts were used. The tantalum lamp (25 c. p. at 110 volts) was compared with an ordinary carbon incandescent lamp also of 25 cp at 110 volts. At 75, 110, 160 and 200 volts, the tantalum lamp gave out 6.4, 25, 93 and 206 cp, respectively, while at the first three voltages the figures for the carbon filament lamp were respectively 2.5 cp, 25 cp and 209 cp. All the four tantalum lamps tested survived the 200-volt test, but the carbon lamp burnt out after 3½ minutes. The latter was badly blackened, too, while it is said that the tantalum lamps were hardly blackened at all. No figures as to the life of the tantalum lamp are given. At the four voltages named the tantalum lamp consumed 20, 40, 76 and 112 watts, while the consumption for the carbon lamp at the three first voltages amounted to 42, 96 and about 220 watts respectively. The consumption of the tantalum lamp at the four voltages mentioned was computed to be 3.1, 1.5, 0.8 and 0.6 watts per candle-power, respectively, and that of the carbon lamp was 16.8, 3.78 and 1.1 watts per candle-power for the three first pressures.

Glasgow vs. American Municipal Ownership.

In an interview at Minneapolis, Mr. James Dalrymple, superintendent of the Glasgow, Scotland, municipal electric railway system, expressed doubt as to the success in America of municipal electric railway ownership. Mr. Dalrymple's lines in Scotland, according to his own statements, seem to be easy going, easily handled and managed properties, unhampered by politics, where fares are charged by the mile, where no transfers are expected or given, and where the mileage is short—in fact, about the reverse of municipal ownership ideas in big North American cities. Bad service, he declares, was the great incentive of municipal ownership in Glasgow. Here, he thinks, a large element of politics must necessarily enter into the controversy between street railway corporations and city governments. And in politics, says Mr. Dalrymple, lies the germ which eventually will kill municipal ownership in America. When asked if he thought municipal ownership of street railways in America could be made a success. Mr. Dalrymple answered that the existing conditions in this country were so vastly different from those in his Scottish city that he was not prepared to make a statement.

Some Electrical Observations Abroad.

We give below the result of some observations made by Mr. L. J. Auerbacher during a recent trip to Europe, and relating to various electrical matters:

The English steamer on which Mr. Auerbacher took outward passage had one side of the wiring system grounded, using only one wire and the iron frame of the boat as the return. The three dynamos were not run in parallel, which made it necessary to have each feeder terminate in a three-way switch, so that it could be fed from either machine, in order to properly distribute the load. The cut-out panels were something like our telegraph fuseboards and were contained in a wooden cabinet. The deck wires were run in wooden mouldings. The electrical plant was installed three years ago.

In London the pleasant light of the Bremer arc lamp was much in evidence. The Strand and other thoroughfares had many of these lamps and their subdued reddish hues made a pleasing contrast with the harsh white rays of the arc. On the continent many of these lights were observed, even in the small towns. The economy of the Bremer lamp was said to be much greater than that of the arc.

Mr. Auerbacher found, notwithstanding the rigid Board of Trade rules, that British methods of wiring are out of date and even dangerous if referred to our National Code rules as a standard. A great deal of the wiring is done with flexible lamp cord and poor cord at that. Single-pole tumbler switches are the standard, and when a double-pole switch is required the handles of two single-pole switches are yoked to a bar and operated together. The cut-out panels were mostly single-pole, using fuse wire and set in a wooden unlined cabinet. There appeared to be little concealed wiring and such as was noted was of the old brass-bound fibre conduit kind, which in this country has been condemned for some years. Flush switches are seldom used and the more clumsy and unsightly the device the better it seems to be liked. Fixtures are wired with thinly-covered No. 20 flexible cord. A favorite design in fixtures is to bring the cord out of the arms about six inches and then attach the sockets, making a drop light effect.

The present telephone system of London is designated as the worst form of human aggravation. An ancient sort of desk set is used, having a transmitter and receiver combined on a handle, similar to the Swedish type. After a dozen twists of the magneto generator handle, one picks up the handle and if he is an expert gets the transmitter at the mouth instead of the ear. A small ridge which operates a cut-out is then pressed and the inquiry made, "Are you there?" If fortunate in getting an answer and in addition do not forget to keep pressing the cut-off in the handle like a wrist exercise (and twice as tiresome), one can talk to the party called without getting disconnected more than once. The government is now, however, having a modern central energy system installed and no doubt the present inconveniences will in time disappear.

In France and Germany the wiring systems are similar to the English. A great deal of No. 18 B. & S. wire is used for circuit wiring, and in many instances the wires are stapled to the beams.

In Germany the Auer osmium and the tantalum incandescents are coming into use, the latter to a greater extent than the former. The osmium lamp consumes 1.5 watts per cp, but costs $1.75, and can only be burned in a vertical position, while 75 volts is the highest limit of voltage. These disadvantages naturally limit the commercial success of the lamp. The tantalum lamp consumes 1.9 to 2 watts per cp, costs $1 and is made for 110-125 volts. The bulbs are usually frosted and the light is pleasant.

The Nernst lamp is used quite extensively in Germany, many factories being lighted with them. Quite a number of installations visited used direct current and upon inquiry it was found that very little or no difficulty was experienced from electrolytic action. In France and England Nernst lamp installations are few and far between. Germans, like Americans, are quick to adopt new things of merit, whereas the Englishman is ultra-conservative.

Western Association of Electrical Inspectors Organized.

Electrical inspectors connected with the Underwriters and with municipal electrical inspection departments in States west of and including West Virginia, met in Chicago June 1 and 2 and organized the Western Association of Electrical Inspectors. One of the objects of this association is to bring about uniformity in the interpretation of the electrical code and to exchange experiences in a way which will result in improvements in the rules for electrical installations. The meetings were held at the assembly rooms of the Underwriters in the National Life Building, Chicago. About thirty were in attendance at the first session. Officers were elected as follows: President, F. D. Varnam, St. Paul; first vice-president, W. B. Hubbell, Cincinnati; second vice-president, E. B. Ellicott, Chicago; secretary and treasurer, W. S. Boyd, Chicago. The executive committee consists of the officers and six others, as follows: E. R. Townsend, Chicago; Waldemar Michaelsen, Omaha; George W. Gano, Louisville; Fred. G. Dustin, Minneapolis; George D. Doyle, Chicago; Frank V. Sackett, Chicago.

In the afternoon a tour of inspection was made and the members visited one of the local theatres, where the lighting equipment of a traveling company was inspected. The new car wiring and fireproofing of the Metropolitan Elevated Railway was also inspected, the Metropolitan Elevated road placing its new steel car at the disposal of the visitors to take them to the shops at Throop Street. An inspection of iron conduit work in the addition to the Union League Club building, finished the afternoon's tour.

In the evening a banquet was held at the Bismarck Hotel. Mr. E. R. Townsend, of Chicago, acted as toastmaster. Among those who made addresses were W. H. Merrill, Jr., chief of the Underwriters' Electrical Bureau, Chicago; William Carroll, the new city electrician, of Chicago; Waldemar Michaelsen, city electrician of Omaha; F. D. Varnam, the newly elected president of the association, and F. V. Sackett. On the morning of June 2 the last session was held and a number of standing committees were appointed on the following subjects; National Electrical Code; Laws and Ordinances; Grounding of Conductors; Outside Wiring, and Theatres and Shop Equipments. As most of this meeting was taken up with the work of getting organized, but little discussion of technical points was indulged in. There was a brief discussion on the enclosing of cut-out cabinets and on the point of whether the association would be of benefit to municipal inspectors in attempts to reduce hazards to life as well as hazards to property. The value of uniform theatre requirements was brought up, on account of the number of companies which carry electrical equipment with them.

The association closed its first convention with over 85 members, three-fourths of whom were municipal inspectors. Municipal inspection has been brought about in a large number of cities largely through the educational efforts of the Electrical Bureau of Fire Underwriters. On Friday afternoon, after the last meeting, a number of laboratory experiments were carried out for the benefit of the members at the Underwriters' Laboratories, 67 East Twenty-first Street. This included a test of the dielectric strength of rubber-covered wire and tests of porcelain link fuse cut-outs, link fuse rosettes, snap switch, key socket and flush switch. The present address of the secretary, Mr. William S. Boyd, is 67 East Twenty-first Street, Chicago. Mr. Boyd is electrical inspector of the Electrical Bureau of the National Board of Underwriters, his office being in the offices of the Underwriters' Laboratories. These laboratories will about July 1 be removed to 382 East Ohio Street.

New York Lighting.

Governor Higgins has signed the Stevens lighting investigation committee's bills fixing the price of gas and electricity in New York City. These bills fix the price of gas furnished the City of New York for municipal purposes at 75 cents per 1,000 cu. ft.; fix the price of electric light furnished private consumers in New York City at 10 cents per kw-hour, except that 12 cents may be charged in Kings County, and with the further exception that the bill shall not apply to the Fifth Ward of Queens Borough; fix the price of electric light furnished New York City for municipal purposes at 10 cents per kw-hour, except that 12 cents may be charged in Kings County, and fix the price for electric street lamps consuming 450 watts at $100 per year, at $90 for electric street lamps consuming 325 watts, and at $65 per lamp where two electric street lamps are attached to a single pole. These prices are not to apply to that portion of Bronx Borough lying east of the Bronx River.

Test of 400-Kw. Westinghouse-Parsons Turbine Unit.

Messrs. F. P. Sheldon & Co., of Providence, R. I., have reported on a test which they recently made on a 600-hp Westinghouse-Parsons turbine direct-connected to a 400-kw Westinghouse polyphase generator of the revolving-field type, installed in the works of Joseph Benn & Sons.

The object of the tests was specifically to determine the fulfillment of the builders' guarantee of the steam consumption at various loads and under various conditions, and, incidentally, to observe the general efficiency of the steam turbine for its intended work. It was particularly desired to determine the efficiency of the turbine independent of the generator, consequently separate tests were made on the steam turbine and the generator. To insure the utmost accuracy, brake tests were made on the turbine. The exhaust steam from the turbine was condensed in a surface condenser and the condensed steam weighed. The results of the eleven official economy tests conducted upon the turbine are shown in the following table, which also gives the builders' guaranteed steam consumption. It will be noted that the actual results are considerably better than the builders' guarantee.

SUPERHEATED STEAM.

Steam at 150 lbs. pressure and 100° F. superheat, vacuum 28 inches.	Lbs. steam per brake hp. per hour. Full load.	¾ load.	½ load.
Guaranteed water rate in lbs. per electrical hp. per hour	14.8	15.5	16.9
Guaranteed generator efficiency	94.5%	93.5%	91. %
Equivalent water rate in lbs. per brake hp. per hour	13.98	14.49	15.38
Lbs. steam used per brake hp. during test	12.48	13.45	14.34
Percentage better than guarantee	10.9%	7.2%	6.7%

SATURATED STEAM.

Dry saturated steam at 150 lbs. pressure, vacuum 28 inches.	Lbs. steam per brake hp. per hour. Full load.	¾ load.	½ load.
Guaranteed water rate in lbs. per electrical hp. per hour	16.4	17.2	18.7
Guaranteed generator efficiency	94.5%	93.5%	91. %
Equivalent water rate in lbs. per brake hp. per hour	15.5	16.8	17.
Lbs. steam used per brake hp. during test	13.89	15.05	15.86
Percentage better than guarantee	10.3%	10.4%	7. %

The tests show the turbine capable of carrying great overloads. It will be noted that even an overload of 108 per cent was carried by the turbine with excellent economy. This desirable feature is brought about by an automatic secondary governor valve with which the turbine is fitted, which valve begins to operate only when the load on the turbine has reached about 700 hp, or about 15 per cent overload. This feature permits the turbine to operate at its best economy at or near full load and at the same time it provides ample means for sustaining large overloads.

The governor of the turbine is so constructed that its sensitiveness may be altered within broad limits. This turbine unit is intended ultimately to operate in parallel, and therefore required a speed regulation at or near 4 per cent.

A governor test was run with the following results:

Load.	R.P.M.	R.P.M. variation.	Per cent. of variation.
0	3,620	+ 124	+ 3.55
1/2	3,541	+ 45	+ 1.29
Full	3,496	0	0
1 1/2	3,460	— 36	—1.03

Extreme variation, ½ to 1½ load, 2.32 %.
Extreme variation, 0 to 1½ load, 4.58 %.

Observations on regulation made during the regular load test were as follows:

Load.	R.P.M.	R.P.M. variation.	Per cent. of variation normal.
1/2	3,559	+ 59	+ 1.69
Full	3,500	0	0
1 1/2	3,475	— 25	—0.71
Twice full	3,450	— 44	—1.26

Extreme variation, ½ to twice load, 2.95 %.

The effect of superheated steam upon turbine economy was very marked, and the divergence of the two water lines corresponding to the tests with saturated and superheated steam was practically uniform. Expressed in approximate terms, the results of these tests indicate that the steam consumption is reduced 10 per cent per 100° F. superheat throughout the range of tests.

Following are the data of the turbo-generator, which was tested separately:

REVOLVING FIELD, THREE-PHASE, TWO-POLE.

Excitation, separate	100 volt.
Rated full-load capacity	400 kw.
Full load current per terminal (100% power factor)	527 amp.
Voltage, normal	440
Frequency, cycles	60
Speed (revolutions per minute)	3600

The measurements included (1) iron loss in armature, (2) resistance of armature, (3) resistance of field, (4) saturation curve, (5) insulation tests. From these data the following efficiencies were calculated. As the losses due to bearing friction and windage are small and are not easily segregated from other losses, they were neglected:

Efficiency.	Guaranteed.	Measured.	Excess.
Full load	94.5%	96.6%	2.1%
3/4 load	93.5%	95.7%	2.2%
1/2 load	91.0%	94.6%	3.6%

The above efficiencies take into consideration: (1) The hysteresis and eddy-current losses in armature iron, determined by driving the generator at full speed, first fully excited and then without excitation. The difference in power consumption represents the total iron loss. (2) The I^2R loss in armature coils, determined from measured resistance of winding. (3) The I^2R loss in field coils, determined from voltage drop in windings, checked by separate resistance measurements.

Cheaper Telephones for New York.

The Board of Estimate and Apportionment of New York City on June 3 held its first meeting under the law which transferred to the board the powers held by the Board of Aldermen in the matter of franchises. Among the applications for franchises was that of the Atlantic Telephone Company, of which Joshua B. Powers, of Louisville, Ky., is president. The company promises to give cheaper telephone service if a franchise is granted it

The application sets forth that the company was organized in 1901, and it has a capital of $25,000,000, and intends to issue bonds to the amount of $15,000,000. Already it has 75,000 contracts with citizens for telephone service, and will charge five cents a call. The company says that it has seventeen exchanges.

A blanket franchise covering all the boroughs is asked for. The company, in its application, asserts that there is need for 250,000 more telephones in Manhattan at once, and that if the prices were reduced there would be at least 250,000 more subscribers. A hearing will be given June 30.

Indiana Independent Telephone Interests.

As a result of the flurry caused by the sale of the United Telephone Company to the Bell people, a consolidation of all independent toll line interests in Indiana, along the lines of the Ohio independent toll line companies, will be effected. A committee, of which Mr. S. P. Sheerin, president of the New Long-Distance Telephone and of the Indianapolis Telephone Company, is chairman, was appointed at a meeting held in Indianapolis on May 26, at which fifteen companies were represented. This committee is empowered to effect some kind of arrangement among the independent companies whereby a repetition of the coup just executed by the Bell people will be impossible. The method adopted by the Ohio companies was thoroughly discussed and favored, and the telephone men present confidently believe it will be adopted. George W. Beers, a prominent telephone man of Fort Wayne, says that the sale of the United Telephone Company, instead

of being a blow to the independents, is really the best thing that could have happened, since it will have the effect of bringing the independents closer together. "We expect to fix things so that treachery will be impossible," he said.

A meeting of independents will be held in Fort Wayne, at which the committee will make a report as to the best plans for establishing and maintaining independent service in the field recently acquired by the Central Union. It is claimed that the people and city authorities in the United Company's territory are ready and willing to assist the independents cover the field and believe that the unexpired contracts with other independent companies will be carried out in a half-hearted way only. Some of these contracts run for six years, some for twenty and one for ninety-nine years. It is believed that the moment the independents install a system in the acquired territory the Central Union will refuse to carry out the contracts. The warfare, therefore, promises interesting results. On the other hand, the officials of the United Company say it is simply a traffic agreement between the United and the Central Union. There was no transfer of property The United Company will continue its contracts with other independent companies, and there is no reason why those companies should be alarmed at the situation. There will be no change except at Marion, where the Central Union exchange will be discontinued or united with the United Company's exchange and many patrons relieved of the expense of keeping up both telephones. The principal reason for the combination is that the two companies have been maintaining an expensive warfare in the territory and both lost money. The United Company, it is said, will continue under the same management as before, except that Horace F. Hill, of Indianapolis, manager of the Central Union, is made a member of the Board of Directors. The Bell Company gets a portion of the stock, but the change gives the United Company's plants connections over the Bell toll lines as well as its own.

Telephone Picnic.

The Telephone Protective Association, composed of representatives from Boone, Clinton, Tipton and Madison Counties, Indiana, was, on May 25, entertained by the Union Telephone Company, of Carmel. The purpose of this Association is to promote the interests of the exchanges of small towns and their subscribers, who are, for the most part, farmers.

A paper was read by Mr. Charles F. Norton, secretary of the New Long-Distance Telephone Company, of Indianapolis, on "Toll Systems." One of the problems of the independent telephone service, he said, was where exchange service should end and toll service begin. In towns and cities exchange service is normally defined by the corporate limits, but in rural districts the distinction is not so easily drawn. He referred to the benefits to the farmer from independent service.

About fifty exchanges were represented at the meeting. Similar associations are being organized among independent telephone exchanges in contiguous counties all over the State. At the close of the meeting a big basket supper was spread and 500 persons enjoyed the first telephone picnic of the season.

Report on Electric Canal Haulage.

In his final report, recently submitted, Senator Merton E. Lewis, of Rochester, chairman of the commission appointed in March, 1904, to examine the electric towing systems that might be applied to the canals of the State, says that the committee was favorably impressed with the "electric mule" tested at Schenectady on July 20 of last year. But in view of the rapid progress of electrical science and the fact that the barge canal will not be completed for several years, the commission believes it inadvisable to recommend the adoption of any system at this time.

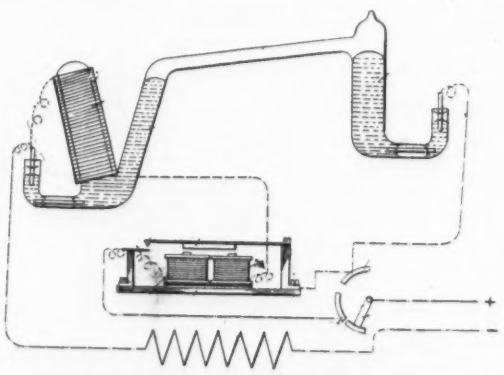
"The members of the board were favorably impressed with the demonstration on the present Erie Canal at Schenectady by the International Towing & Power Company, and while they have no official knowledge of the commercial value of that system of towing, because of the fact that the demonstration was not conducted by the board officially, still the members of the board feel that it is quite possible that upon the enlarged canal such system or some similar system may be used advantageously for a considerable portion thereof, between Tonawanda and Montezuma and between the head of Oneida Lake and the Mohawk River, at or near Herkimer or Little Falls."

CURRENT NEWS AND NOTES.

A JAPANESE HERO.—The Japanese Emperor recently awarded the posthumous degree of the Order of the Kite to the memory of three Japanese officers selected as the "bravest of the brave." One of these, Lieut. Ichikawa, was an electrical engineer, and formerly chief electrician in succession of the Odawara Electric Railway Co., the Keihin Electric Railway Co. and the Fukagawa Electric Light Co. At the outbreak of the war Mr. Ichikawa enlisted as an infantry lieutenant and on several occasions performed acts of heroism, in the last of which—at the Battle of Mukden—he lost his life. Previous to the battle, in expectation of his return to Japan, his electrical confreres had arranged for a triumphal reception, but Lieut. Ichikawa remained over to take part in the movement on Mukden. To be one of three to be thus brevetted as a hero in a war abounding in acts of heroism, is indeed a distinction, but one well-earned by Lieut. Ichikawa.

STATE GAS AND ELECTRICITY COMMISSIONERS.—Governor Higgins has appointed as Commissioners of Gas and Electricity James R. Sheffield, of New York; Lucien L. Shedden, of Plattsburg, and ex-Attorney-General John C. Davies, of Camden. Each commissioner will receive a salary of $8,000 per annum. The commission is to receive $500 a month for traveling expenses for themselves and employes. It is to have an office in Albany, one in New York and one in Buffalo, and must meet at least once a month at its Albany office. It will have supervision of all gas and electric light, heat and power companies, and may fix the standard of gas furnished, as well as establish a standard of pressure at which gas shall be delivered. Books of corporations may be examined by the commission and comprehensive reports are to be filed by the corporations, which hereafter cannot be organized except with the consent of the commission, nor can they increase their stock or issue bonds, nor can one corporation transfer or lease its franchise to another without the consent of the commission. The mayor of a city, the trustees of a village or the town board of a town of 100 customers may demand of the commission an investigation as to the price or quality of gas or electric light furnished, and the law makes it possible for the commission to enforce its orders by mandamus.

STARTER FOR MERCURY VAPOR LAMP.—In a patent issued May 30 to Richard Küch, is disclosed a method for starting the arc in a mercury vapor lamp by bringing the electrodes in contact. The circuits of the lamp are shown in the accompanying illustration. The glass vessel comprises an inclined tube for the arc light, a chamber containing mercury as the positive electrode, a wide tube for containing mercury as the negative electrode and an auxiliary chamber, which contains mercury, and communicates with



the negative electrode. When the mercury in the auxiliary chamber is heated, vapor will be developed in the upper space and force the level of the mercury up the inclined tube until it flows over in the upper chamber and communicates with the positive electrode. The heating of the auxiliary chamber is effected with the aid of an electrical resistance, which surrounds it. The preliminary heating device is cut out of circuit manually after the two electrodes are brought into contact.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.—As already announced, the next meeting of the Interstate Independent Telephone Association will be held in Chicago, June 20 and 21. Three days will really be devoted to the object of the meeting, June 22 being devoted to inspecting and visiting exhibits and to such entertainment as manufacturers, supply dealers, etc., may provide. A banquet will be held on the evening of June 22. Mr. P. C. Burns, Chicago, is chairman of the entertainment committee.

LONDON TUBE PLAN.—A cable dispatch of May 29 from London says: "The special committee of the House of Commons, appointed to consider the matter, has decided against the Pneumatic bill, providing for the installation in London of electric light and pneumatic tube systems similar to those in use in America. There was considerable opposition on the part of the municipal authorities on the ground that the work would necessitate much tearing up of streets. It is understood that J. Pierpont Morgan was among the promoters of the company, which had a capital of $20,000,000. Ninety-five miles of double tubing and 172 stations were proposed. Other details have already been noted in these columns.

HORSES AND AUTOMOBILES.—In the early days of the automobile it was a common prediction that horses would eventually be replaced by the mechanical power vehicle. In this country there does not seem to have been any diminution of the number of horses, but in France, according to a publication from Amsterdam, there has been a decrease in the number of horses in use. From 1903 to 1904 the number of horses in Paris dropped from 91,016 to 90,147, a difference of 869. In 1901 there were 133,892, making a decrease in 1904 of 43,745 as compared with 1901. At Lyons the same thing was observed, although there the underground railway may have contributed. In France, in 1903, there were 20,000 vehicles, representing a value of about $40,000,000.

OBJECT TO THE SEARCHLIGHT.—A special telegram from Washington, D. C., says: "The War Department is receiving a novel complaint from vessel owners on the Potomac. Tug owners and steamboat captains say that they are being watched so closely by the searchlights of the coast artillery posts that they are seriously inconvenienced in navigating the river. The artillerymen are coaching up for the manœuvres to occur in June and spend the night watching every craft that goes up or down the river. The big searchlights blind the pilots. One man, it is said, has been permanently blinded. The master of a vessel who turns his light into a pilot house is liable to have his license revoked. The War Department authorities will put a stop to the abuse."

THE TRUTH ABOUT GLASGOW.—Regarding the visit of Mr. Dalrymple, of the Glasgow municipal tramways, to Chicago, now seeking to municipalize its trolleys, the New York *Times* probes the Glasgow fallacies deeply and inquires: "Is it not true that the central zone in Glasgow within which the railroad fare is one cent contains a densely crowded population living in what are politely called unsanitary conditions, meaning filth and wretchedness? Is it not true that in order to reach a part of the city where the conditions of healthy living can be found the fare paid on the tramways is greater than the workingmen of New York pay on our corporation lines to reach their homes in suburbs remote from the crowded district? Is it not true that the tendency of the zone system established by the City of Glasgow is to put a premium upon congestion and overcrowding of population in tenements and to discourage the growth and spread of the city outward from the center? In other words, has not the City of Glasgow in operating its street railway lines devised about the most unwise, unsanitary and injurious policy it could possibly have adopted? On some of the street railway lines of the City of New York a workingman can ride about fourteen miles for five cents. He can go from the Battery to One Hundred and Ninety-fifth Street. By the Subway he can go from Fulton Street to One Hundred and Fifty-fifth Street. In Brooklyn he can go nearly to Coney Island for five cents, and all the way there for ten. A single fare of five cents takes many of the working class of New York from the scene of their labors to a separate individual home with green grass growing around it. Mr. Dalrymple says the fares in Glasgow paid by the 'wealthier classes' who live in the suburbs range 'from three to six cents.' Is it not true that it costs about sixteen cents to ride as far upon the Glasgow street cars as a New York passenger is carried for five cents?"

REGULATOR FOR MERCURY VAPOR LAMP.—In the operation of mercury vapor lamps it has been found that the effect of an increase of temperature is to increase the resistance between the terminals. It is stated that the lamp frequently goes out under the influence of variations in temperature. In a patent issued May 30 to Mr. A. G. Davis it is proposed to provide a thermostatic arrangement for controlling a rheostat in the external circuit of the lamp. Surrounding the tube is a band which consists of two layers of different metals, one within the other and having their contacting faces soldered together. The coefficient of thermal expansion of the inner layer is greater than of the outer layer, so that any increase in temperature to which this band is exposed causes the band to unbend. In series in the lamp circuit is placed a rheostat, the position of whose arm is controlled by the expansion and contraction of the thermostatic band.

ELECTRIC SMELTING IN CANADA.—A test is to be made at the Soo of electric smelting, according to Mr. R. R. Garney, of the Ontario Legislature. He says: "Mr. Clergue, of the Soo, with his usual foresight and energy, has offered the department a building and free power for electricity for four months, and as they have a splendid outfit of machine shops and skilled labor, all available at reasonable cost, it has been decided to experiment at the Soo, where ore from various localities can be assembled cheaply and quickly. Dr. Heroult is to be in charge and make the tests. Experiments will also be made in treating the nickel ores of Sudbury locality, as there are quantities of the nickel mattes at the Soo. The plant will not be in operation for a couple of months, as the furnace is not fully designed yet, and the electrodes have to be imported from Sweden, nothing of the kind being available here."

CENTRAL STATION CO-OPERATION IN GERMANY.—A consular report recently stated that 28 firms belonging to the Union of Electric Manufactures recently met in convention in Munich and organized a society for the purpose of purchasing supplies for the manufactories. The use of the word "manufactories" was an error, the information applying to the electric central stations furnishing light and power in the various towns in Germany, which are co-operating in many ways, just as the Association of Illuminating Companies in the United States. The co-operative society for the purchase of supplies is formed chiefly for the purpose of testing and controlling the purchase of incandescent lamps, so that the illuminating companies may standardize their requirements as much as possible and assure the best service for their customers. The electric manufacturers in the ordinary sense of the term, i. e., those who sell machinery and supplies, have nothing whatever to do with this arrangement and have no co-operative society for purchasing their supplies.

THE ILLUMINATING ENGINEER.—Our London contemporary, the *Electrical Review*, says it is a curious circumstance that, whereas the methods of electrical generation and distribution have been parcelled out into special subjects, the actual object of the process—illumination of premises—is often left either to the decorator, the architect, the fittings manufacturer, or the non-technical owner of premises. The borough electrical engineer and his assistant sometimes offer well-meant advice, but, being more intimately connected with the heavier branches, they have not sufficiently studied the subject of illumination to be ranked as specialists. There is now, it says, a field for a specialized illuminating engineer whose consideration should be directed to such points as the proper position, grouping, shading and reflecting of lights; the installation of circuits to obtain the maximum number of lamp-hours per equipment; the æsthetic arrangement of the lighting in public buildings, such as art galleries, theatres and churches, and economies connected with the selection and renewal of incandescent and other types of lamps. That such an engineer is required, can be seen by noting the defects in lighting found at present in public and private installations. Lamps are hung so as to be unavoidable by the eye and are hence most irritating; at the other extreme we have lamps so densely shaded that the bulk of the light paid for is wasted. The grading of illumination is improperly carried out. The same candlepower per unit area is found in the library, the dining-room and the billiard room. Our contemporary believes that the benefit of such a calling would be immense to both the supply station and the consumer.

BARON ROTHSCHILD.—Baron Alphonse de Rothschild, of Paris, who died last week, was one of the early backers of electric light and power development, and some years ago was made an honorary member of the National Electric Light Association of this country.

AUTOMOBILES IN MALTA.—Mr. John H. Grout, United States Consul at Valetta, Malta, writes as follows: "Not content with a new tram line recently inaugurated, a company has been formed to run a service of public electric buses between points in Malta not yet covered by the tram line. The company is building a garage, which will be fitted for storage of its vehicles and for the repair of its own and other motor cars. A complete installation will be provided, offering facilities for charging accumulators for electric carriages. For public service there will be a 20-hp, 17-seat, single-deck bus; four 24-hp, 36-seat, double-deck buses, and one 24-hp lorry. All of the vehicles will be fitted with electric lights. It is expected that the new service will be opened about June 1."

LECTURES AT THE STEVENS INSTITUTE OF TECHNOLOGY.—The following special lectures are scheduled for the senior class during May and June of the present year: Mr. John W. Lieb, Jr., M.E., "The Generation and Distribution of Electricity in New York City"; Mr. Philip Torchio, "Principles Governing the Design of Systems for Electrical Distribution"; Dr. Louis Duncan, "The Development of the Electric Railway"; Mr. Charles E. Downton, "Shop Methods and the Apprenticeship System of the Westinghouse Electric & Manufacturing Company"; Mr. C. J. H. Woodbury, "Telephone Line Engineering"; William R. Baird, M.E., LL.B., "Patent Law"; William O. Ludlow, M.E., "Architectural Engineering"; George C. Hill, C.E., "Form and Surveying," "Building and Cost Keeping"; Prof. William H. Bristol, M.E., "Recording Instruments for Pressure, Temperature and Electricity"; E. R. Douglas, M.E., "Motor Drive for Machine Tools."

A DAM FOR NIAGARA RIVER.—A meeting has been held in Washington of the International Deep Waterways Commission to consider plans for building a dam across the Niagara River at the Lake Erie mouth, to raise the levels of the Great Upper Lakes, thereby permitting the use of vessels of greater draft and tonnage. As will be seen, not only are shipping interests vitally interested in the project, but there must be taken into consideration the great power plants at Niagara, as well as the scenic features of the cataract. The construction of a dam would result in flooding many acres along the New York and Canadian shores and would affect the electrical enterprises at the Falls in various ways. The members of the commission representing the United States are Gen. Oswald H. Ernest, Corps of Engineers, U. S. A.; Hon. George Clinton, of Buffalo, and Prof. G. S. Williams, of Ann Arbor, Mich., while the Canadian members are W. F. King and Louis Coste, of Ottawa, and J. P. Maybee, of Toronto.

Electrical Engineers o the Times.—XIII.

MR. F. J. DOMMERQUE.

Franz Joseph Dommerque was born November 26, 1861, at Duisburg, Germany, and is descended from a family which left France to escape persecution at the time of the Revolution of 1789. After receiving a complete classical education, he entered in 1880 the Mathematical Institute of Zurich, Switzerland. Here, under Moellinger and at the Polytechnicum under Fiedler and Frobenius, he studied higher mathematics until 1882, when he entered the German army to perform the legal compulsory service of one year as volunteer. Leaving his regiment at the end of the year with the rank of lieutenant of the reserve, he followed the mechanical engineering course at the Technical University of Munich until 1886, supplementing the instruction there received by practical work in the shops of Hartmann & Co., at Offenbach-on-the Main, builders of steam engines.

At the beginning of 1887 Mr. Dommerque went to England for the double purpose of learning the English language and to gain a close view into British technical development. During his stay in England he drifted into electrical engineering with the Schmidt-Douglas Electric Company, of Bradford. This was during the pioneer days of electric lighting in England, and having to rely entirely upon his own resources, he obtained through this connection a practical education in the design, installation and operation of electric light plants. A desire to see America, with its greater progressiveness, brought him to Chicago at the end of 1888, where he commenced as a draughtsman for the Western Electric Company. A year later he joined the Thomson Electric Welding Company, of Lynn, Mass., where he participated in the development of electric welding machinery. In 1890 he took up electric railway work with the United Electric Traction Company, of Jersey City, N. J., and a year later engaged in the design of small electric motors in the works of the Singer Manufacturing Company at Elizabethport, N. J.

In 1892 he returned to Germany with the intention of devoting his future years to the manufacture there of electric machinery, but soon missing the enterprising and busy life of the American engineer, he severed home ties for the second time and returned to Chicago as representative of Allweiler & Co. at the World's Fair of 1893.

At the close of the fair Mr. Dommerque accepted an offer to enter the engineering department of the Chicago Telephone Company, where during the next six years he added his share to the development of telephone engineering, devoting himself principally to original investigations on the economical design of large telephone plants,

MR. F. J. DOMMERQUE.

where his mathematical training came in good stead. During his residence at Lynn, when studying alternating-current phenomena, he had realized the advantage afforded by the application of imaginary quantities to alternating-current work, and while with the Chicago Telephone Company he commenced a series of articles in *Electrical Engineering* on "Elements of Complex Quantities and Vectors with Reference to Their Use in Alternating-Current Work." The series, however, was never completed: first, because the magazine changed its editorial policy; and second, because the appearance of Mr. Steinmetz's classic work on "Alternating-Current Phenomena" made continuation superfluous. As a result of this contribution he was elected to membership in the International Association for the Promotion of the Study of Quaternions and Allied Subjects of Mathematics.

In 1889 Mr. Dommerque joined the staff of the Kellogg Switchboard & Supply Company, of Chicago. The first years in his new position were taken up with outside engineering, principally in the planning and supervision of switchboard installations, and later his knowledge of operating engineering was put to good service in the commercial engineering branch. In this capacity he became familiar with all important telephone plants from the Atlantic to the Pacific, and made two extensive business trips to Europe. During this period also he wrote extensively on the subject of telephone engineering.

For a year and a half Mr. Dommerque has been secretary and a director of the Kellogg Switchboard & Supply Company, but still continues his commercial engineering work, supervising at the same time all foreign patent cases of the Kellogg Company. He has been a member of the American Institute of Electrical Engineers since 1896.

The Hydro-Electric Power Station at Ladermier.

BY S. HERZOG.

ONE of the chief disadvantages of the many hydro-electrical central power stations is the difficulty of dealing with an irregular water supply. This is chiefly met by the construction of valley dams and the formation of natural reservoirs. In the Swiss Jura there are many natural lakes having sufficient elevation to enable their power to be utilized. Such a lake is Lake Joux, in the Canton of Vaud, into which the river Orbe flows. The Orbe flows through a subterranean way and comes out at Ladernier, 205 km. distance from Vallorbes.

The position of the lake is extremely favorable. The water is taken from the lake by a channel 2.7 km. long, 2.2 meters broad and

FIG. I.—POWER HOUSE AND PIPE LINE.

2.6 meters high, and leads into a reservoir blasted in the rock, and lined with concrete. The water level of this reservoir is about 997 meters above the sea. The height above the sea of the Orbe flowing out of the lake is 759 meters. The total fall is, therefore, 238 meters. The "Compagnie Vaudaix des Forces Motrices des Lacs de Joux et de l'Orbe," was formed to utilize this for generating electric power, and the work of constructing all the necessary electric apparatus was entrusted to the Maschinenfabrik in Oerlikon.

The power equipment is of particular interest because of the large extent of the hydraulic distributing system and the many arrangements devised to meet the demands for safety in operation. To protect the generators against moisture, the center of the axles of the machines was raised to 2.5 meters above the high-water surface of the Orbe, so that the gross fall was reduced to 234 meters.

The hydraulic part of the station is at present only half completed. There are installed one pressure pipe line, five generators and two turbines for exciting purposes. The pipes between the dam and the distributing pipe system are divided into eight sections. The pipe diameter decreases from 1.2 meters to 1 meter; along the descent the thickness increases from 8 mm. to 20 mm. on account of the increase in pressure. In the curves the pipes are supported by walls, or "saddles," which have to withstand a considerable downward pressure. A view of the pipe line is given in Fig. 1.

The expansion and contraction is compensated for in four places. The total length of the pipe line is 640 meters. At the end is the hydraulic distributing system and a set of piping with an inner diameter of 400 mm. for the turbo-generators, and one pipe for the exciter having an inner diameter of 150 mm. At the entrance to the first named distributing system there is a throttle valve, worked from inside the power house. At the same place a second valve is arranged to connect the piping up with the second lot, after the station has been extended, to allow each set of piping to work independently. For each turbine there is a separate valve. These are worked from the gallery, which affords a good view of the turbines and the manometer panel.

Each turbo-generator at a net fall of 234 meters, takes 412 liters per second. This corresponds to 1,000 hp at the turbine axle. Each of the two exciting turbines gives at the same fall and at 65 liters per second 150 hp. The turbines were delivered by Escher, Wyss & Co., of Zurich.

All the turbines are of the free-flow Francis type. The turbo-generators have wheels of 1.7 m diameter. The wheels of the exciting turbines have 800 mm diameter. The entrance of the water into the shell-shaped buckets of the turbines is regulated at the opening by a cone, which in turn is regulated by a speed governor. This latter works directly on the regulating valve, which reacts more or less strongly on the regulating piston. Since this piston and the cone are connected, it follows that a difference of the pressure above the piston alters the position of the cone. Every change of position of the pendulum of the governor alters, therefore, the section of the entrance. To prevent the water from producing shocks when suddenly cut off, each turbo-generator is fitted with a governor which effects a slow and gradual cut-off. Each turbine is equipped with a revolving filter to cleanse the water.

The guarantee demands an efficiency of 78 per cent at full load, and 76 per cent at three-quarter load. The alteration in the speed with a sudden change in power of 55 per cent is not more than 4 per cent. At a sudden change from full load to no load, the change in speed is not more than 13,5 per cent. Running normally the alteration is not more than 1 per cent. If three turbines are cut out at the same time, it is arranged that the pressure should not increase more than 10 per cent of the normal value. The coupling of the generator to the turbine axles is effected by Zoddel's elastic belt clutch.

The generators are designed for 13,500 volts and 50 cycles per second. Each is built to absorb the full effect of 1,000 hp from the turbine with a power factor of 0.75 when producing polyphase alternating current, and a power factor of 1 when producing single-phase alternating current. See Fig. 2. The inner diameter of the armature ion is 2 meters, and magnet-wheel diameter is 1.98 meters. The armature of these 16-pole machines contains 72 coils in 144 open slots (3 slots per pole per phase). Each coil contains 20 turns of 4.4×5.0 mm wire. The field windings consist of 16 coils in series, made of broad copper strip, 35 by 1.6 mm. All the armature

FIG. 2.—INTERIOR OF POWER HOUSE, SHOWING SWITCHBOARD PLATFORM.

coils are form wound, and are insulated by seamless mica coverings. A damaged coil may be replaced with a coil from the reserve stock in about half an hour. The several magnet coils are held together to one solid body by cast steel plates.

The e.m.f. curve of the generator differs only in a minute degree from a true sine. This effect was obtained by bevelling the edges of the pole faces.

A heat test was made with the generators by coupling two of them together and over exciting the one and under exciting the other, so that the tension at the terminals was 15,000 volts and the current strength 50 amperes. With this 30 per cent overload, a constant rise in temperature was measured for about 8 hours. The maximum rise was 35 degrees above the temperature of the atmosphere. The normal load was 43 amperes at 13,500 volts; for this load a temperature rise of 60 degrees was allowed in the guarantee.

With this same test with the two generators, it was possible to measure directly the efficiency of the generators at full load with a purely wattless current by determining the absorption of energy by the motor driving the machine that was generating the current,

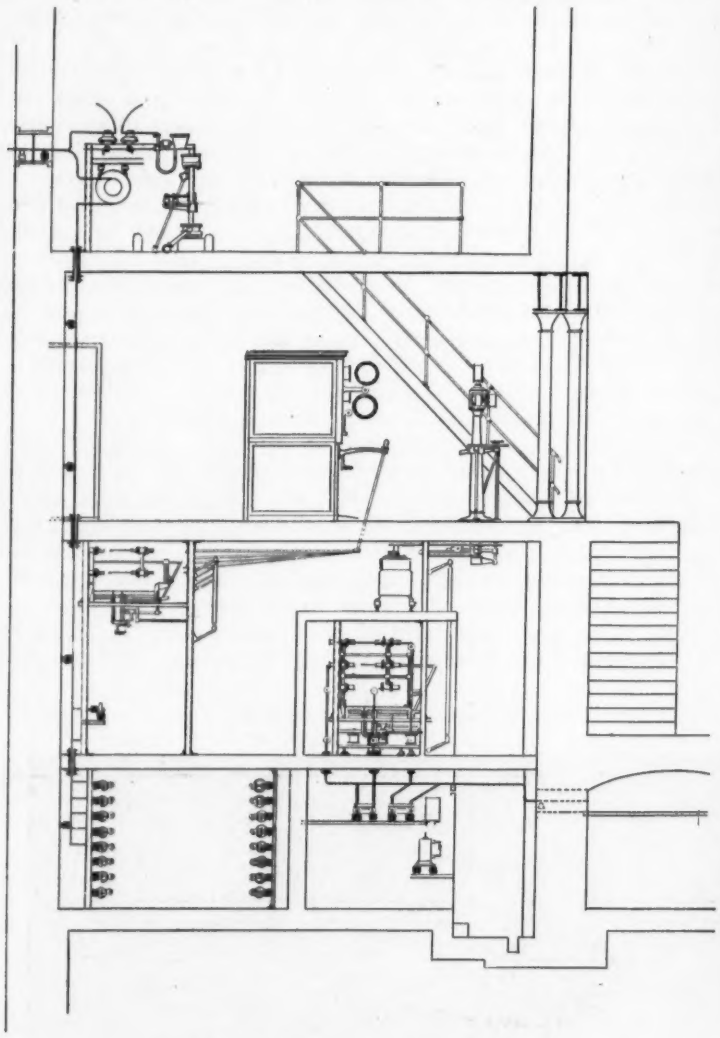


FIG. 3.—ARRANGEMENT OF SWITCH GEAR.

and by reading off with a wattmeter the energy absorbed by that generator which was running at no load as a synchonous motor.

The losses in the generators were measured by driving them with direct-current motors. These results checked very closely with the calculated losses and the losses that were measured directly. The so-called additional armature losses at full load were only 10 per cent of the joulean losses directly determined from the true resistance. It is well known that the load losses can amount to 100 per cent of the joulean losses with alternators having solid-pole pieces. The insulation of the windings was tested for one hour with a pressure of 30,000 volts between the housing and the windings.

Each exciter coupled with its turbine absorbs 150 hp, and is a 6-pole machine built to deliver a direct current of 800 amperes at 90 volts. The exciters are capable of carrying full load for a stretch of 24 hours, without the temperature of any mechanical or electric part exceeding the temperature of the atmosphere by more than 45 degrees. The efficiency at normal speed and full load is 92 per cent.

For the safety of the attendants and of the installation itself, all high-tension apparatus and conductors are divided off by arrangements on different stories. (See Fig. 3.) This, however, was not considered enough, and in each story, each particular group of apparatus and conductors is divided from the rest, and arranged in fire-proof concrete cells.

It is well known that nearly all stoppages in the working of central stations are due to mistakes by the attendants in the handling of the apparatus. Particular care was taken in this case to avoid this trouble by a well-thought-out system of inter-blocking switches. All connections are so liberally dimensioned that the possibility of overheating is excluded. The switches may be opened at full load without producing any arc. The lightning arresters work without any lasting arc. The copper earth plates are large, and embedded in good conducting earth. Without exception, all the high-tension apparatus and wires are insulated by porcelain.

All the bus-bars are arranged in the north passage of the lower

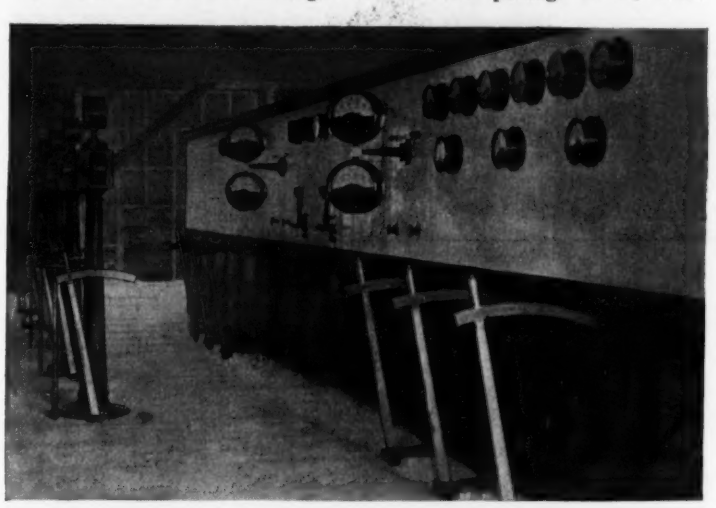


FIG. 4.—SWITCHBOARD AND INSTRUMENT COLUMNS.

floor. The one circuit serves for the single-phase lighting current, the second for the three-phase power current, the third for the three-phase transformers. Switches enable the cutting out of all the apparatus of one machine group or circuit without at the same time affecting the rest of the installation through the interlocking system.

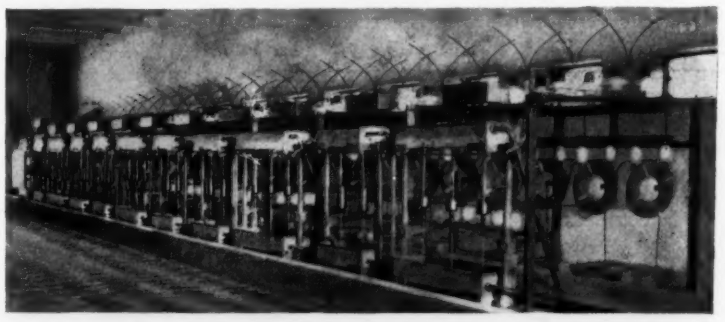


FIG. 5.—LIGHTNING ARRESTERS.

The neighboring passage of the same floor contains the switches, meter transformers, and current transformers for the generators. The transformers, etc., for the instruments connected with the generators are arranged in one cell, the switches for the same generator are arranged in the next one. This arrangement enables each generator to be switched on to one of the three looped circuits. By means of a special system of locking, the switches may be operated only when the principal switch is open, that is, when there is no current flowing. This, of course, increases the safety immensely. These switches are worked by a hand-wheel, which is put upon the platform in the third floor, near the instruments belonging to the same machine.

For the purposes of inspection and changing the transformer fuses there is a long corridor running past the cells, and parallel to this one is a second which holds the cables coming from the exciters and the generators. There are two rows of cells in the

second story, on the same floor as the machines, and in front of each row runs a passage. Each cell of the north row contains a high-tension switch with automatic maximal current breaker, and the switches for the ammeter of each feeder. These switches are operated by a lever working in a vertical plane, which is connected up by a linked joint with the switchboard on the third floor. See Fig. 4. The movement of the hand-lever is transmitted to the switches by a systems of levers made of gas piping.

The cells on the same floor, approached by the second passage,

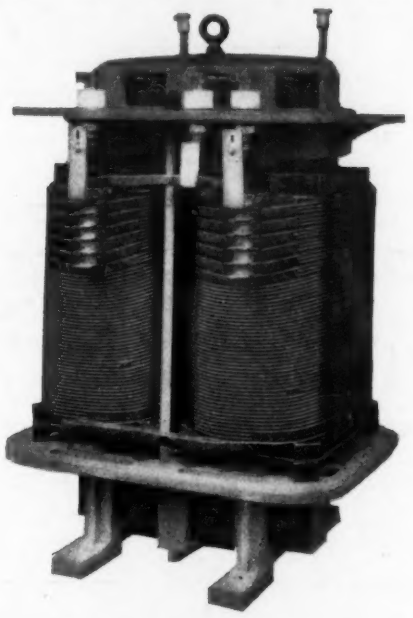


FIG. 6.—SINGLE-PHASE TRANSFORMER.

are each subdivided into two cells, one over the other, by a horizontal concrete partition. In the bottom half there is the high-tension switch with the automatic maximum current breaker for each generator; the top half contains the main switch for the same generator.

All connections to the high-tension switches are laid in tubes and insulated with porcelain. These switches enable a safe interruption of the current to be made in the corresponding circuit. The automatic contact-breaker works independently of the lever arrange-

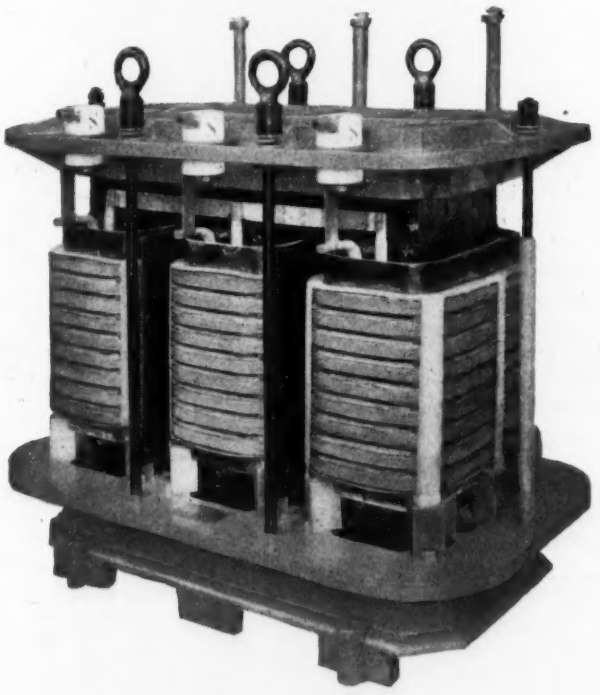


FIG. 7.—THREE-PHASE TRANSFORMER.

ment, that is, the latter is not operated or affected by the former. This independent working was necessary because in case of any short circuit causing the automatic arrangement to work, a rigid connection between this and the levers would have caused the latter to have been torn out of the hands of the attendant.

This independent cutout arrangement works so that the link-joint connection between the automatic switch and the levers is broken, and the switch is opened as soon as the maximal current flows through a magnet coil; at the same time the lever makes a slight movement independent of the automatic working, which warns the attendant that the switch has been opened. To free the link-joint connection, the attendant has to bring the hand-lever up into the open position, which forms the connection again between the lever gear and the switch.

The real control space is on the third floor, which affords a good view over all the machinery. It is divided in two parts by a marble switch panel supported on iron. The front part looking into the machine room, is where the instrument columns for the generators are located. These columns, which are made of cast iron, carry the brackets for the different levers and hand-wheels to control the gear, and the various meters. The current is carried up the center of the columns, which are hollow. Each column is fitted with an alternating-current ammeter, a wattmeter, and an ammeter for the circuit of the exciters. The guides for the hand-levers of the high-tension gear, and for the axles of the hand-wheels for the controller and the carbon switch, are fixed on the column. As above mentioned, the main switch, the change-over switch, and the switches for the exciter are so locked together that a false manipulation of the gear is impossible.

The switchboard in its present dimensions consists of twenty-two panels. The link-joint guides of the hand-levers for the circuit switches are fastened on panels for the lighting circuit. On both of the general instrument panels are two revolving voltmeters, two synchronizing lamps, and two voltmeter change-over switches, by which each generator may be switched on to one or other of the meters. Two general instrument panels were, therefore, provided in order always to be able to control the power and lighting systems, even while connected in multiple circuits.

The exciter panels contain the levers for the control of the starting switch of the exciting circuit, the hand-wheel for the shunt resistances, as well as the voltmeter and the ammeter for measuring the current. The panels for the power system are arranged similar to those for the lighting system, only there are three ammeters provided (one for each phase).

The lever switches, with automatic spark extinguishers for the exciting current, are arranged behind the switchboard. These

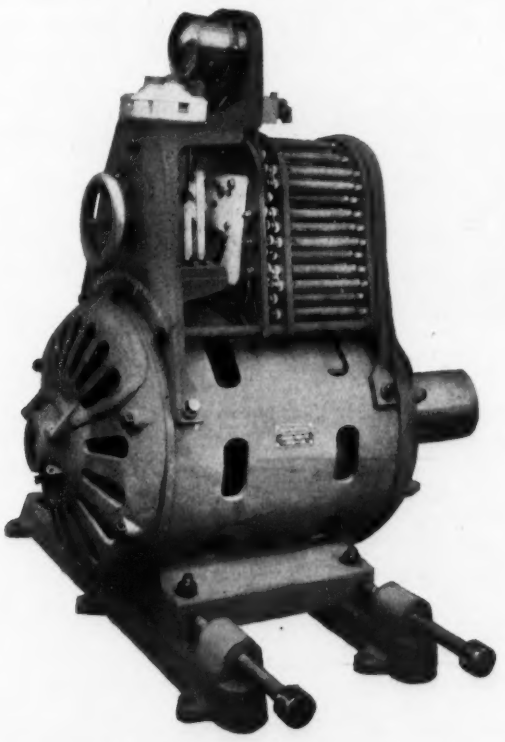


FIG. 8.—SINGLE-PHASE MOTOR WITH STARTER AND AMMETER.

switches are worked by a jointed lever mechanism, and are provided with auxiliary carbon contacts.

The various safety fuses and lightning arresters for violent atmospheric discharges, and for the increases in tension in long overland systems are arranged on the third floor, as seen in Fig. 5.

A large number of single-phase transformers were delivered for

the installation. These are remarkable for the perfection of the insulation considering the small capacity of the transformers. Those transformers of 5, 10 and 20 kw capacity had their insulation tested for one hour with a tension of 30,000 volts between the iron and the high-tension windings. This was about three times as large as the working tension.

The construction of the transformers without oil insulation, working only with the natural ventilation of the air, has led to surprisingly good results with respect to small weight and high efficiency, in spite of the high insulation demanded. The 10-kw transformer has, for example, a total weight of 330 kg, the 30-kw transformer a total weight of 510 kg. The respective efficiencies are 95.5 per cent and 96.5 per cent. As seen in Fig. 6 the secondary coil is provided with five taps, so that motors may be used at the same voltage along the whole system. The construction of the type of three-phase transformer in use may be seen from Fig. 7.

Among others, numerous single-phase motors were delivered for this installation, to drive threshing machines. With these transportable motors, starters, ammeters and fuses were provided, so that they could be connected up with the system at any point by a cable. (See Fig. 8.) The motors are built for 10 hp and have at full load an efficiency of over 80 per cent and a power factor of 86 per cent.

Measuring the Slip of Induction Motors.

By F. Lawton Stone.

THE accurate measurement of the difference between any two large quantities, experimentally obtained, has always been a very difficult task. If it is attempted by the method of observing both of the large quantities and then subtracting the one from the other, the result is always open to question. Suppose the one value is 900 and is read one-half of one per cent low, and the other value is 910, and is read one-half of one per cent high, so that the former appears to be 895.5 and the latter appears to be 914.5. By subtraction the difference seems to be 19.00, when, as a matter of fact, had everything been read with absolute accuracy, a difference of only ten would have been found. The error in the result is 90 per cent. It is of course absurd to think that in commercial testing results can be obtained with an error less than one-half of one per cent. The experimental determination of the slip of an induc-

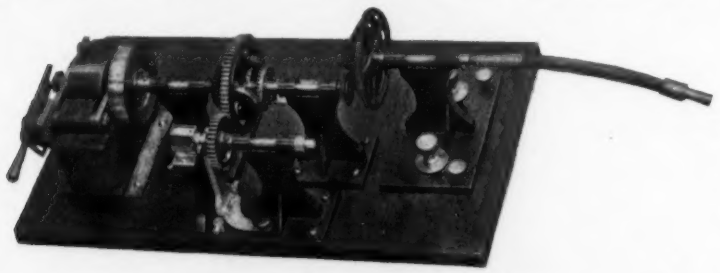


FIG. 1.—DEVICE FOR MEASURING THE SLIP OF INDUCTION MOTORS.

tion motor depends upon the accurate measurement of the difference between two large quantities, i. e., the synchronous speed and the actual speed, and an error of 1 per cent in the reading of these quantities may make an error of 100 per cent in the result.

To overcome this difficulty several ingenious methods have been devised. The simplest of these is, perhaps, the disc and arc lamp method which, in a word, consists in attaching to the shaft of the induction motor a disc with as many black and as many white sectors as the motor has poles. When the disc is viewed in the light of the arc lamp, the sectors will be seen to revolve slowly backward at a rate equal to the slip.

If the slip is not over 40 per minute it may be counted by following one sector with the eye. If the slip, however, is over 40 it becomes very difficult to follow, and the results accordingly uncertain. Also, the light from the incandescent carbon is often so great that the difference between the maximum and minimum light is not enough to allow one to distinguish the sectors. Furthermore, a very large "personal equation" of the man counting the slip has to be considered, so that altogether this method is not highly satisfactory.

Realizing the uncertainty of the above method and the importance of accurate slip measurements, the author, about a year ago, made use of a piece of apparatus composed of a differential gear and synchronous motor, which has practically eliminated all trouble and is perfectly automatic, recording the slip on a counter.

A very clear idea of the device can be gained from Fig. 1. To the left is a small synchronous motor with a speed corresponding to a four-pole machine. There is a differential gear in the center and a nest of gears on a movable pedestal at the right. The gears in this nest are so proportioned that they correspond to the speed of motor having from 2 to 12 poles. If the slip is to be taken on a 12-pole motor, the dowel pins and thumb screws in the base of the pedestal are removed, the large gear engaged with the pinion of the differential gear, the dowels replaced, and the thumb screws replaced. There are dowel holes corresponding to each gear, and the slot in the base allows the base to slide back and forth.

The motor for this device is a four-pole, single-phase, synchronous machine of rather unique design. The revolving part, which in reality corresponds to the field and on the number of whose poles or projections depends the speed, is built up as shown in Fig. 2.

The cross-shaped pieces are made of laminated steel and keyed to the shaft, and the spaces between the projections are fitted with

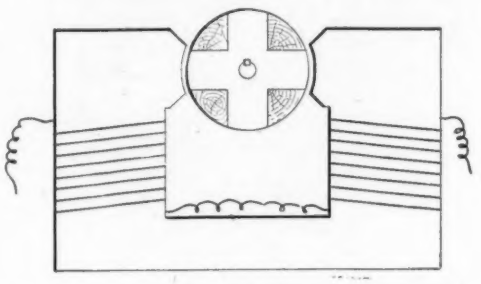


FIG. 2.—CROSS-SECTION OF SYNCHRONOUS MOTOR.

wooden blocks. The stationary part is built up of laminated steel. The operation of the motor is purely magnetic. The current reaches zero just as the rotor assumes the position shown in the sketch. The momentum of the revolving parts carries the rotor past this point, so that when the projections are advanced 45° the current and flux are maximum and exert a pull upon the projections. Such a motor is, of course, not self-starting. When it is necessary to make the motor self-starting there is attached to the shaft a contact device which breaks the current when the rotor is in the position shown in the sketch, and completes the circuit when the rotor advances a few degrees, and so on continuously for each 90°.

The direction of rotation depends alone on the direction in which the motor is started by hand. To start and synchronize the motor for the slip machine, it is only necessary to connect the flexible connection to the shaft of the induction motor and hold the differential gear stationary by hand. This will bring the motor up to the speed of the induction motor. The circuit to the synchronous motor may then be closed, and the motor will jump into synchronism at once. The differential gear will then revolve at a rate which is directly proportional to the slip.

If the poles on the induction motor are four (the same as on the synchronous motor) the differential gear will travel at a speed equal to exactly one-half the slip. To take care of this factor (½) the diameter of the counter gear is one-half that of the gear about the differential system.

When taking observations of the slip the load on the motor is held constant, and the e.m.f. and speed of the alternator as nearly constant as possible. The counter, before being engaged, is read and the reading recorded. Then at a signal, or simultaneously with the starting of the stop watch, the button in the base of the machine is pressed down. This engages the speeder shaft with the small gear of the differential system. At the end of a specified time the button is released and the counter disengaged. The new reading on the counter is now recorded, and the difference between the two divided by the number of revolutions of the synchronous motor is the slip of the induction motor expressed with synchronism as unity.

The design of this slip recorder has been altered somewhat within the past few weeks, so that the counter reads the slip directly for any number of poles on the induction motor. This result has been obtained by changing the gearing, so that the differential gear is driven directly from the induction motor, and the gearing is so arranged that the speed of the synchronous motor equals the synchronous speed of the induction motor.

Protection for Railway Power Stations.

BY MORTIMER SILVERMAN.

THOUGH modern practice has somewhat changed the method of connections in large railway power stations, yet many are connected as the one to be discussed below. In view of this fact, the following information is given for the benefit of those engineers who have a like proposition to deal with.

Fig. 1 shows the method by which the class of station referred to is connected. The equalizer is in the positive side, thus necessitating the placing of the main circuit-breaker and meter in the negative side.

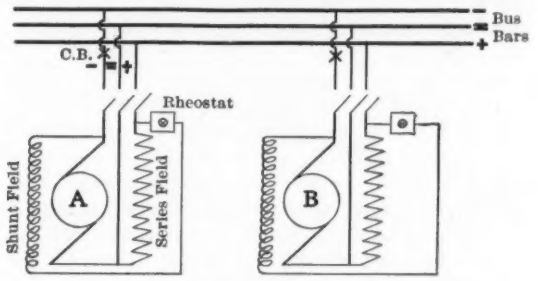


FIG. 1.—DIAGRAM OF CONNECTIONS.

Consider now the case of a ground in the armature of generator *A*. The breaker may or may not knock out, and in fact it is immaterial as to whether or not it does, for the ground exists through the engine and piping. Under these conditions the only relief is to pull the positive and equalizer switches. If the switchboard man is at hand he may save the other machines, but in most cases there is not sufficient time. Thus in all probability the whole road will be affected, and besides, the weaker in insulation of the other machines may be grounded. This condition has been noted several times by the writer, and in fact, as many as three generators have gone up at the same time in the particular station referred to. This latter fact may, of course, be charged to the imperfect operation of circuit-breakers. Aside from this, there is still another difficulty in the fact that the other generators ground through the defective one and the resulting arc usually burns quite a hole in the laminations around the grounded coils of the defective machine.

The equipment of the station protected consists of eight 800-kw, direct-connected, 575-volt machines. The object was to supply additional safety apparatus to accomplish first, additional protection for overload in case of failure of main breakers; second, protection to other machines in case of grounding of one; and third, to protect the grounded machine itself. The following method was pursued:

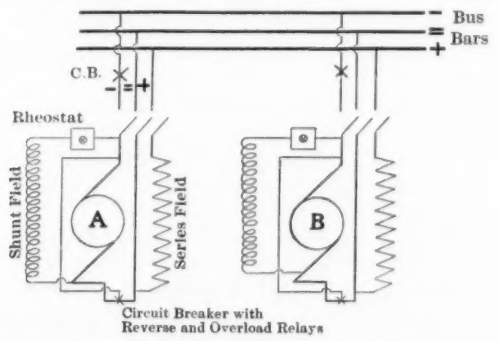


FIG. 2.—DIAGRAM OF CONNECTIONS.

Circuit-breakers of a reliable type were procured, having both overload and reverse current relays, and mounted on pedestals. These were mounted near the individual machines and connected as shown in Fig. 2. The flexible lead on the positive side between the brush ring and equalizer lead was removed and the cables from the circuit-breaker substituted. A potential wire was also run from the negative side of the breaker to excite the reverse current coils.

Consider under these conditions the case of a ground on generator *A*, Fig. 2. The first result is loss of potential and thus of load. This is, of course, followed by a reversal of direction of current flow, the current flowing from either or both positive and equalizer busses into the grounded machine. The reversal of current will immediately knock the breaker and thus clear the bus of the ground, at the same time protecting the defective machine from the heavy current flow into the ground.

Tests were made by cutting in the full rheostat and also by shutting down the engine without handling the switchboard. In all cases perfect protection was secured. The breakers selected operate on reversal of current at from 175 to 625 amperes, according to adjustment.

One point is to be noted in reference to the shunt field circuit. It must be so connected that the breaker in opening will not interrupt the field current; otherwise the inductive kick will be likely to break down the insulation.

Measurement of Small Alternating Currents

BY FREDERICK BEDELL.

A SIMPLE device for measuring small alternating currents is indicated in Fig. 1. In the alternating-current circuit marked *A C*, four lamps, *L*, are connected, two in multiple, two in series. If the four lamps have equal resistance, or if the two lamps of each pair have equal resistance, the points *P* and *Q* will be at the same potential with respect to the alternating current, and hence no alternating current will flow through testing instruments or other circuits connected to *P* and *Q*. The resistance of the lamps changes with the alternating current flowing through them, due to rise in temperature; and hence with proper calibration, the resistance of the lamps may serve to indicate the value of alternate current flowing through the circuit, *A C*.

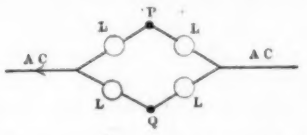


FIG. 1.—DISPOSITION OF TESTING LAMPS.

The resistance of the lamps may be readily measured from *P* to *Q* by a portable testing set without producing any interference of the current being measured with the testing current. A calibration of four lamps thus used by Mr. C. A. Carpenter, senior student at Cornell, is given in Fig. 2. It will be seen that by the use of such a calibration curve, a portable testing set and four lamps can readily serve as an alternating current milliammeter.

In taking readings with the testing set, the galvanometer key is held down and the battery key tapped to see whether the proper resistance is plugged in. The battery current flows only momentarily and does not appreciably heat the lamps. As the lamps are non-inductive this method of momentarily closing the battery circuit is permissible. Direct current may be used for calibration, and either direct or alternating current may be measured by the apparatus.

Resistance devices other than lamps may be used and other suitable methods for measuring their resistance may be employed, using, however, the same scheme of connection as indicated in Fig. 1.

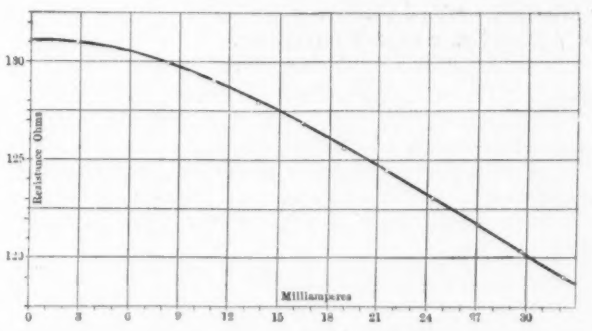


FIG. 2.—CALIBRATION CURVE OF LAMP SET.

Where the resistance is measured by means of a testing current which flows continuously—as with a battery and milliammeter or galvonometer—the calibration with direct and alternating current may be not the same.

Where a single resistance device, instead of four, is employed condensers or reactances or both are needed to prevent the confusion of the testing current and the current being measured. This latter method has been very completely worked out by Dr. Kennelly and described by him in a paper on telephone tests, before

Section G of the International Electrical Congress at St. Louis. An advance copy of this paper has only recently come into the writer's hands. Dr. Kennelly used for a resistance device the "solid barreter" used in the Fessenden system of wireless telegraphy, which proved admirably adapted to the purpose. Four of these barreters arranged as in Fig. 1 should prove well suited for measuring either direct or alternating current and no condensers and special resistance coils need be used. In Dr. Kennelly's use of one barreter, a condenser and reactance are used and apparently the method is suitable only for measurement of alternating current, which is not a serious limitation. There is a loss of sensitiveness, however, in using the arrangement of Fig. 1 instead of the single resistance device of Dr. Kennelly, for the current is divided and each resistance receives only half of the total current to be measured.

Design of a Pantagraph Trolley.

BY C. P. NACHOD.

A PNEUMATICALLY operated trolley for high voltages, called "pantagraph type," from its more or less close resemblance to the familiar linkage used for enlarging or reducing, is shown in the general drawing, Fig. 1. A highly diagrammatic sectional view exhibiting its principles of operation is given in Fig. 2, while Fig. 3 gives the link dimensions.

Referring to Fig. 2, the trolley consists of two linked frames, as *a b c d o*, side by side, in parallel vertical planes, bridged at the top, *c*,

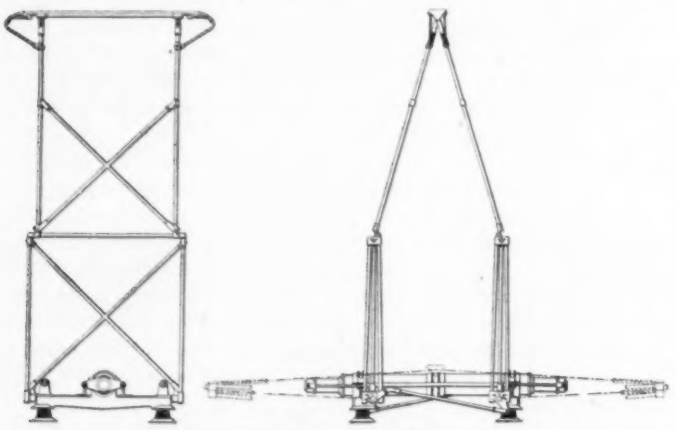


FIG. 1.—PANTAGRAPH TROLLEY.

by the contact shoe; and having the corresponding members of each frame cross-braced so that the two frames move as a unit. The frames are supported on two transverse shafts in bearings at *a* and *o*. The lower members, *a b* and *o d*, have small levers, *h a* and *f o*, rigidly attached, each of which communicates by means of a tension rod, as *f g*, and a compression spring, with a pneumatic piston. These two pistons, between which compressed air is admitted, travel in a cylinder integral with the above-mentioned bearings, forming a base for the apparatus. Four corrugated, porcelain insulating pillars support this base on the roof of the car.

It will be seen that an outward movement of the pistons raises the contact shoe, and that, in order that it may move in a vertical line, the piston travels must be equal. This is accomplished by the equalizing link, *h k*.

In operation the trolley is raised and lowered by compressed air, so that no rope is needed for handling. In raising, the air admitted drives the pistons apart to the end of their travel, where they remain fixed as long as subject to the air pressure. This movement compresses the springs, which raise the contact shoe, all variations in height of the trolley wire being then taken up through the springs. When the air is allowed to escape the cylinder is lowered by the weight of the superincumbent parts.

In some types of pantagraph trolleys, gears are used on the shafts, *a* and *o*, to equalize the angular motion of the lower frames, with the disadvantage that the shaft centers must be brought closer together, making a small base and sacrificing stability; or else idlers are used, complicating the apparatus. The simple stable design given by the equalizing link was originally proposed, it is believed, by Mr. I. D. Paton.

The object of the present investigation is to find, first, if the mechanism is of such a nature that a compressed helical spring can give to the shoe a constant pressure against the trolley wire at all heights of the shoe; and second, to determine the proportions of that spring. The method is of interest independently, as showing the great simplification that may sometimes be effected when analytical and graphical methods are combined.

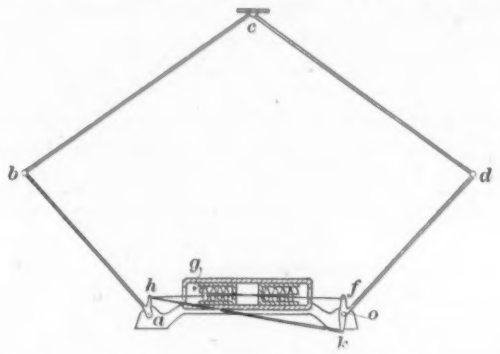


FIG. 2.—DIAGRAMMATIC SECTION SHOWING OPERATING PARTS.

Referring to Fig. 3, in which the weights of the various parts are given as $W_1 = 8.6$ pounds, $W_2 = 21$ pounds, $W_3 = 15$ pounds, $W_4 = 38$ pounds, concentrated at their respective centers of gravities; $Q = 20$ pounds, the assumed pressure between wire and shoe, and P the

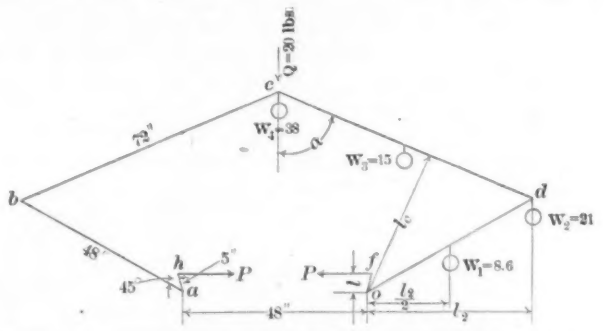


FIG. 3.—DIMENSIONAL OUTLINE OF PANTAGRAPH TROLLEY.

force required to cause this, the equation of moments about *o* may be written

$$Pl = \frac{W_1 l_2}{2} + W_2 l_2 + C l_c,$$

in which l is the perpendicular distance from *o* to the line of action

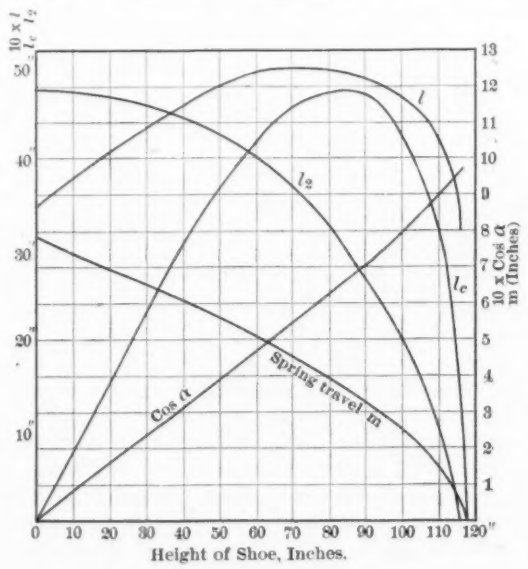


FIG. 4.—PANTAGRAPH TROLLEY CURVES.

of P; l_2 is the length of the horizontal projection of the link, *o d*; *lc* the perpendicular distance from *o* to the link *c d*, and C the compressive force in that link.

On the link *c d* the algebraic sum of the vertical components of the forces upon it equals zero. Therefore,

$$\frac{Q + W_4}{2} + W_3 - C \cos a = 0,$$

where a is the angle made by link $c\,d$ with the vertical.

Eliminating C from these equations, there results,

$$Pl = \frac{l_2 (W_1 + 2W_2)}{2} + \frac{l_c (Q + W_4 + 2W_3)}{2 \cos a}.$$

Substituting the numerical quantities and solving for P, there results

$$P = \frac{1}{l}\left(25.3\ l_2 + \frac{44\ l_c}{\cos a}\right)$$

which is the equation for the force required to give the shoe a constant upward pressure of 20 pounds expressed in terms of the variables, l, l_2, lc and a.

Now, while it is perfectly possible to express these variables in terms of the constants of the frame, with some independent variable, as x, the height of shoe above shaft centers, thus making a complete analytical solution, yet it is impractical to do so, the trigonometrical forms becoming much involved at the very start.

Recourse may be had to the graphical method. The necessary skeleton of the frame, as shown in Fig. 3, may be drawn to a large scale in a number of different positions, ranging from the lowest, with the shoe on a line with the shaft centers, to the highest, with the links $o\,d$ and $d\,c$ in a straight line. The variables required may be scaled from this drawing and substituted in the last equation to obtain values of P. Values thus obtained have been plotted in Fig. 4, where the height of shoe above the shaft centers is used as a common abscissa. It is evident that l is a maximum when the

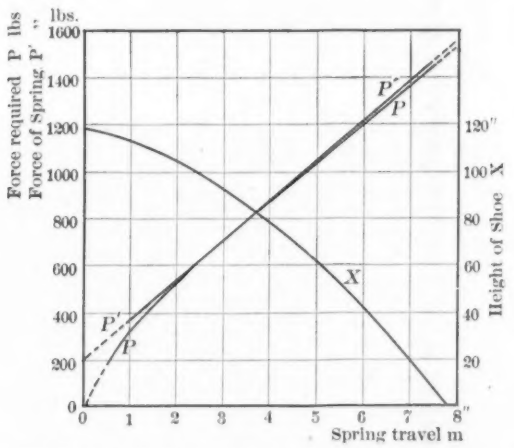


FIG. 5.—CURVES OF FORCE REQUIRED AND FORCE GIVEN BY SPRING.

arm, $f\,o$, is vertical; l_2 is a maximum in the lowest position; lc is a maximum when links $o\,d$ and $d\,c$ are perpendicular, etc.

In Fig. 5 P, the required force as above calculated, is plotted against displacement m of the spring as abscissæ, the origin for the latter being taken with the shoe in the highest position. The part of the curve shown in solid lines is the practical working range to which the motion is restricted by stops. For convenience curve x is here replotted from curve m of Fig. 4.

The straight line, P', taken as most nearly coincident with P, is the characteristic of the proper spring; the co-ordinates of P' being spring pressure and spring travel. By the close coincidence of the curves, P and P', the required force and that given by the spring, the spring is seen to be admirably adapted to the purpose.

The proportions of the spring may be found as follows:

Assume $S = 70{,}000$ pounds per sq. in. shearing stress as a maximum at $m = 7.5$ in. From curve P', Fig. 5, the spring pressure at that point is 1,450 pounds. By the well-known spring formulas,

$$d^3 = \frac{P'r}{.196\,S} = \frac{1{,}450 \times 1.8}{.196 \times 70{,}000} = .19,$$

or $$d = .575 \text{ in.},$$

in which d = diameter of spring wire, r = mean radius of coil, assumed 1.8 in.

From curve P' the gradient of the spring is 166⅔ pounds per inch. Therefore, the total compression is $\frac{1{,}450}{166.7} = 8.7$ in.

$$n = \frac{f\,d\,G}{4\,\pi\,r^3\,S} = \frac{8.7 \times .575 \times 12{,}600{,}000}{4 \times 3.14 \times 1.8^2 \times 70{,}000} = 22,$$

in which n = number of active turns, f = total compression, G = torsional modulus of elasticity taken at 12,600,000 pounds per sq. in. for steel.

Supposing that the adjacent coils are in contact when the spring is fully compressed and allowing for one inactive turn at each end, the free length of the spring is

$$24 \times .575 + 8.7 = 22.5 \text{ in.}$$

The Old Colony Railway Power Plant.

The Old Colony Street Railway Company operates a street railway system serving a territory between Boston and Newport, R. I., about 60 miles long and 30 miles broad. The system includes a number of railways formerly operated independently, each having, of course, its own power station, and when the Old Colony Company began organizing its system as a whole it counted no less than eleven generating stations.

Confronted with this situation soon after it took over the merged properties, plans were made for an entire rearrangement of the

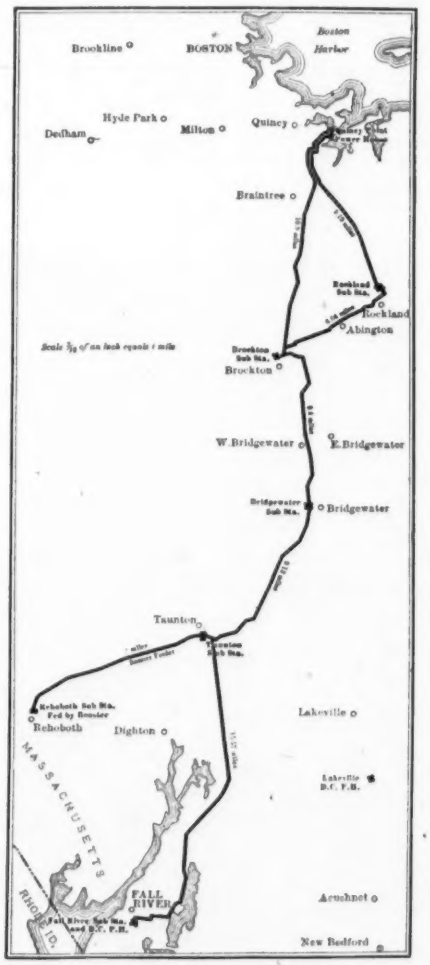


FIG. 1.—LAYOUT OF HIGH-TENSION TRANSMISSION LINES, OLD COLONY SYSTEM.

power generating and distributing layout. After considerable preliminary work these plans resolved down into a general scheme for abandoning all of the direct-current stations and substituting therefor two high-tension, alternating-current generating central stations, one to be located at Quincy Point, a short distance south of Boston, and one at Fall River, these two stations to feed current at high voltage to converting and transforming sub-stations located for the most part at or near the sites of the old direct-current power houses. This scheme, so far as it includes the building of the Quincy Point central station and the installation of several of the sub-stations, has now

been consummated, and the company is already receiving the benefits of an adequate power supply secured at more reasonable cost per unit of output. The original scheme for a second central alternating-current station at Fall River has been laid aside for the present in view of the fact that no difficulty has been experienced in feeding current to Fall River from Quincy Point power house, a distance of 45 miles.

The main station at Quincy Point contains five Curtis vertical steam turbines, each of 2,000 kw normal capacity and 750 r.p.m., and each direct-connected to an alternating generator delivering three-phase, 25-cycle, 13,200-volt current. The current is transmitted at the initial voltage to the sub-stations, of which at the present time six have been installed. The scheme provides for three additional sub-stations, which will be installed as needed.

In the Curtis machines installed the foot bearing is made water-tight and water forced into the bearing at a pressure of about 650 pounds per square inch. This raises the end of the shaft a fraction of an inch from the bearing surface, and the pressure being applied constantly, the effect is to float the shaft and the weight it carries directly upon the thin volume of water which is kept constantly circulating through the bearing by means of a special pump.

The turbo-units have been placed in a single line the full length of the station, and are connected by both lower and upper galleries so that the work of the attendants is brought to the highest possible efficiency. Each turbine has its own condenser, which is of the "Admiralty" surface type, as made by the Wheeler Condenser & Engineering Company. These condensers draw water from a concrete intake sewer that extends under the line of turbo sets, and the water is returned to a similar discharge sewer running parallel to the first. The intake receives salt water from the bay at one side of the building, and the discharge empties into the bay on the other side of the building.

The air pumps and circulating pumps for four of the turbo-units are motor-driven, but the fifth set is steam driven. The condensed steam passes from the condensers to three tanks connected in series, each 20 ft. long by 6 ft. in diameter, located in the boiler room, and which serve the double purpose of a hot well and storage tanks. The feed water for the boilers is taken from these tanks. They are also connected to the city mains, so that if the supply of feed water falls below a predetermined amount the connections to the city mains are automatically opened, thus preventing any likelihood of shortage.

For supplying water under pressure to the step bearings of the turbines there are two motor-driven pumps. As a precaution against a possible stoppage of the supply to the step bearings, there are two "accumulators" in the turbine room. These are in fact vertical storage tanks, in which the column of water is kept under pressure by weights, and which, in the event of a stoppage of the pumps, would supply sufficient water to the bearings to run the plant for about ten minutes, or for a longer period of time than it would take to shut down the machines affected. Although it is believed this precaution is virtually not a necessity, it was decided to install the accumulators so as to make it entirely impossible for damage to occur through shortage of water in the step bearings, which would permit the shaft to drop down to the bearing surface.

The switchboard at this station is of rather unusual design. All high-tension switches and appliances are controlled electrically by low-voltage auxiliary circuits manipulated from a bank board placed in front of the instrument panels, and so arranged as to permit the operator to face the main engine room when controlling the main machines.

The instrument board has the following panels: Five 13,200-volt generating panels, three exciter panels, three alternating rotary panels, three direct-current rotary panels, three 13,200-volt outgoing feeder panels, one direct-current booster panel, one direct-current totalizing panel, and two auxiliary panels—some of these panels, as will be understood, being in connection with one of the sub-stations, which is located on a gallery in the main turbine room. All of the controlling switches are of the high-tension, motor-operated type, placed in cells in the basement below the switchboard floor. All of the lightning arresters for the station are banked in a separate gallery over the switchboard proper.

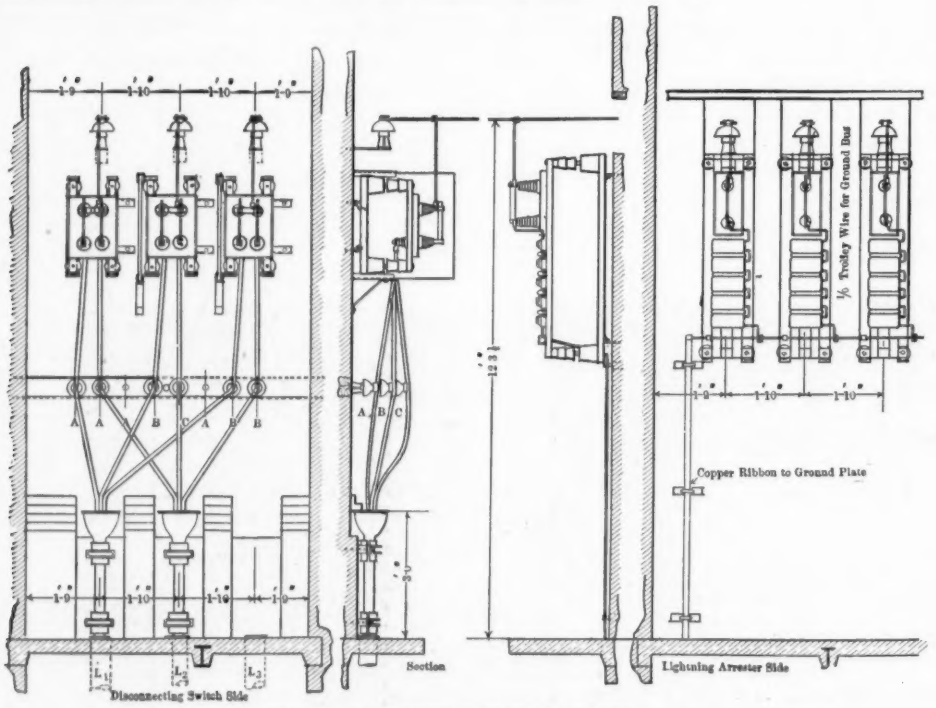


FIG. 2.—FALL RIVER TERMINAL HOUSE.

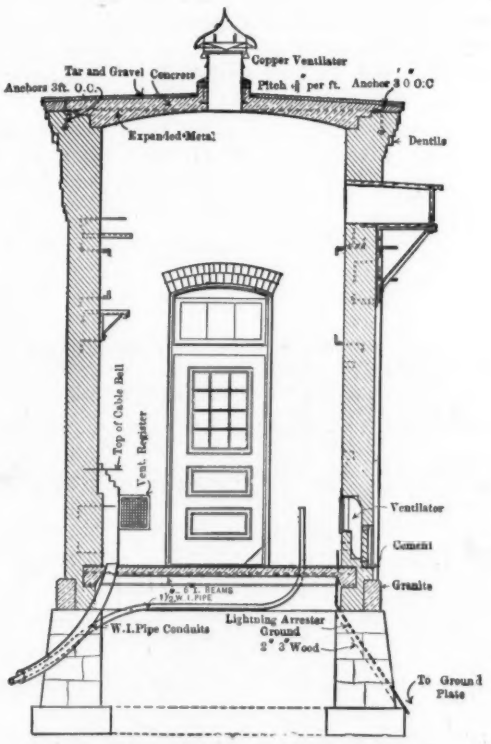


FIG. 3.—ELEVATION OF TERMINAL HOUSE.

At the present time coal for this station is delivered from vessels at a wharf alongside the power house. Coal is unloaded by mast and gaff, and is delivered to the crusher hoppers of the coal-conveying apparatus, which are located in a concrete tunnel that extends from the wharf to a point under the boiler room. The line of bucket conveyors travels through this tunnel and then rises to the coal storage bins above the boilers, from which the coal is fed to the stokers through chutes. The coal conveyor is actuated by variable-speed, alternating motors working on 350 volts. Eventually an elevated coal storage bunker will be erected near the water edge, and the mast and gaff elevators will be supplanted by a modern coal elevating system for unloading vessels.

The broad scheme for power layout calls for nine sub-stations distributed over the territory, so that each sub-station will serve an area of about 5 miles in each direction. These stations will be located respectively at the following points: Quincy Point, Brockton, Milton, Abington, Bridgewater, Taunton, Fall River, Lakeville and Portsmouth, R. I. At the present writing six of these stations have been installed, the location and equipment of each being as follows:

The transforming and converting apparatus at Quincy Point is located along one side of the turbine room in the main generating station. Here are installed three 750-kw, 25-cycle, 600-volt, com-

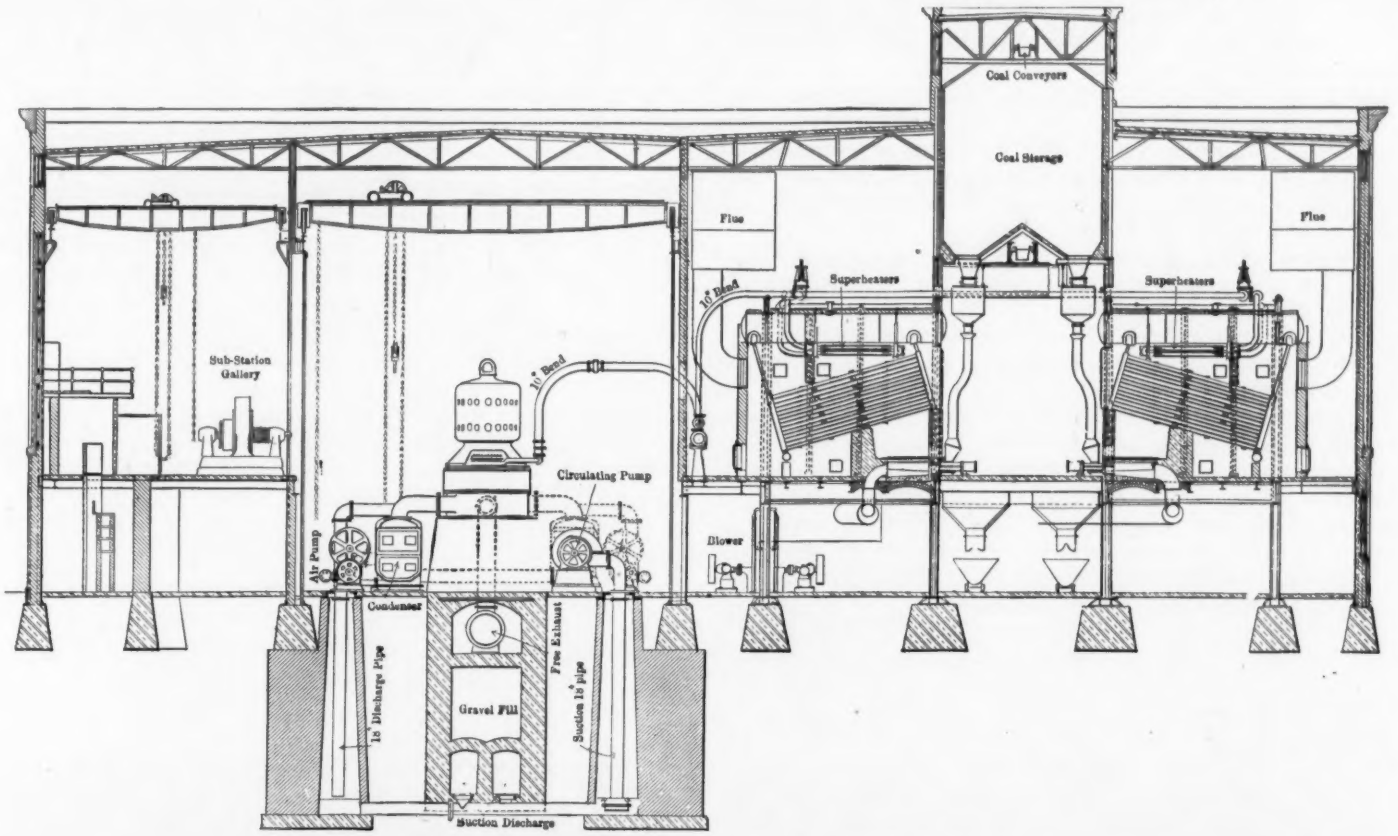


FIG. 4.—SECTIONAL ELEVATION OF QUINCY POINT POWER STATION.

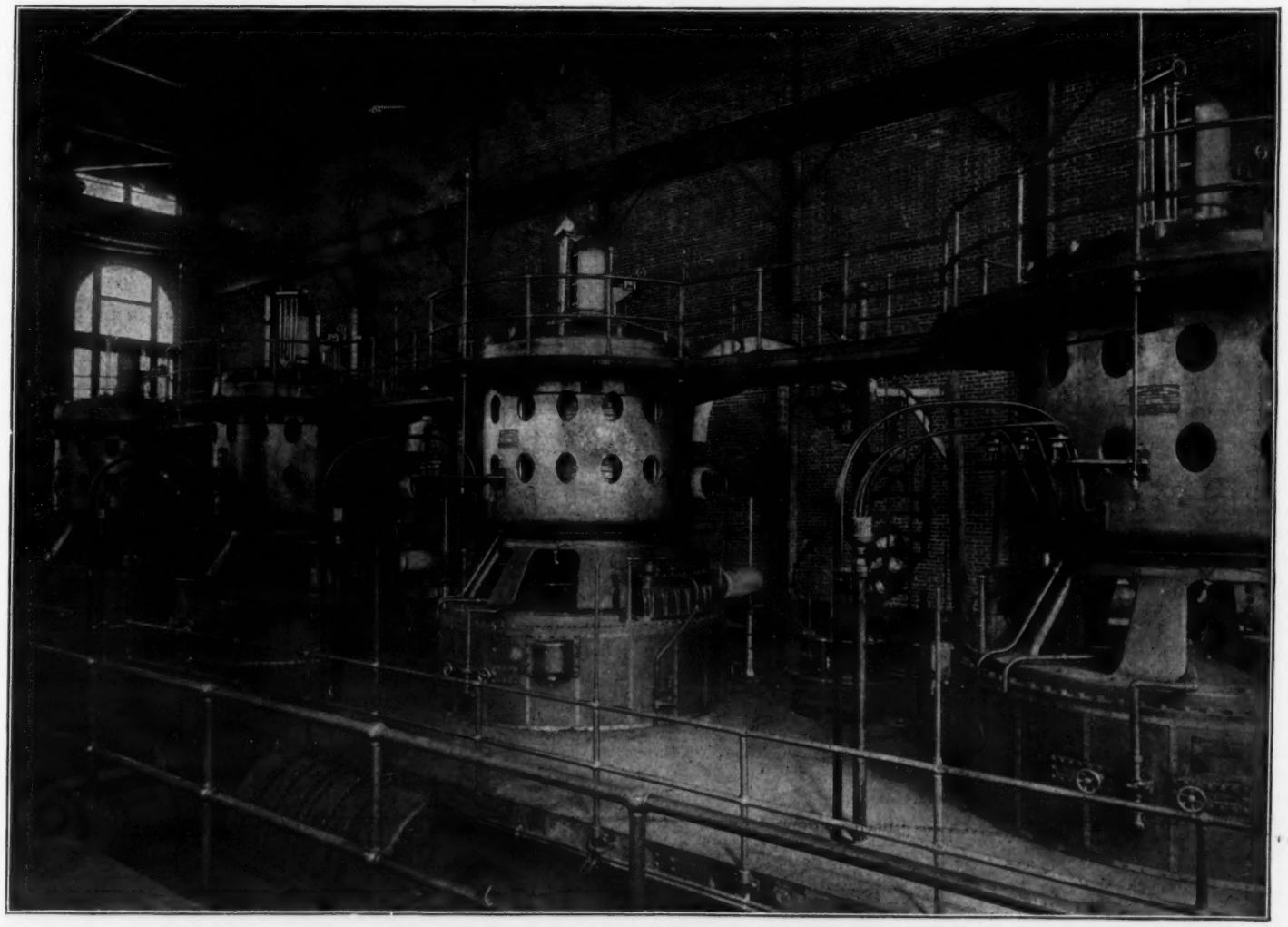


FIG. 5.—INTERIOR OF QUINCY POINT GENERATING STATION, OLD COLONY STREET RAILWAY.

OLD COLONY RAILWAY POWER PLANT.

pound-wound rotary converters, and three 825-kw air-blast type transformers. There is also an auxiliary transformer for delivering alternating current at 350 volts to the various induction motors used for driving the exciter sets, blower sets, condenser pumps, coal-handling machinery, etc.

Three 750-kw converters and three 825-kw air-blast transformers are located at the Brockton sub-station. The switchboard consists of three alternating rotary converter panels, three direct-current rotary converter panels, one incoming high-tension panel, two outgoing high-tension panels, one totalizing direct-current panel and seven direct-current feeder panels.

The apparatus at Rockland consists of three 300-kw rotary converters and three 330-kw air-blast transformers. The switchboard comprises three alternating rotary converter panels, three direct-current rotary converter panels, one alternating-current incoming line panel, one alternating-current outgoing line panel, one direct-current totalizing panel and four direct-current feeder panels. The apparatus at Bridgewater is a duplicate of that at Rockland.

At the Taunton station there are three 500-kw rotaries and one 750-kw rotary, three 550-kw air-blast transformers and one 825-kw transformer. The switchboard consists of four alternating rotary converter panels, four direct-current rotary converter panels, one alternating-current incoming line panel, one alternating-current outgoing line panel, one direct-current totalizing panel and seven direct-current feeder panels. There is also at this station a 360-kw booster set operated by a 450-hp, 350-volt induction motor, the booster being used to furnish direct current to a distributing station at Rehoboth.

At the Fall River station the old direct-current apparatus has been retained and two 750-kw,

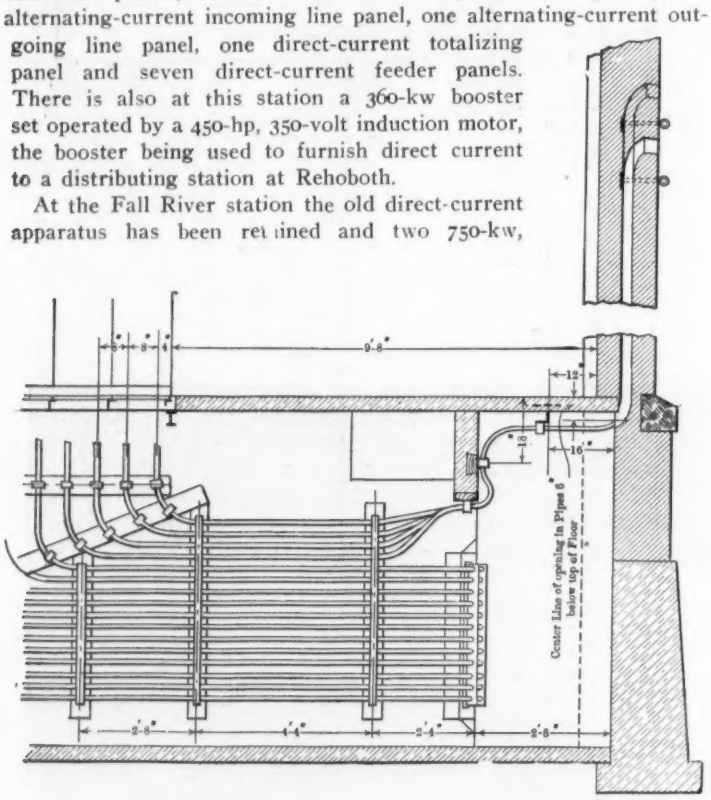


FIG. 6.—DIRECT-CURRENT CABLES ENTERING SUB-STATION.

direct-current generators have been installed to help out on the lines in this locality. There has also been installed a sub-station which receives alternating current from the Quincy Point plant. The sub-station apparatus consists of two 750-kw rotaries and two 825-kw air-blast transformers. The switchboard consists of two alternating-current rotary converter panels, two direct-current rotary converter panels and one alternating-current incoming line panel. The direct-current end of this sub-station feeds into the direct-current feeder panels in the old station, so that at present there has been no change in the direct-current outgoing system.

In general design all the sub-stations are similar, and all the apparatus is of the General Electric Company's latest type for this class of service. The transformers are somewhat unusual, in that there is but one transformer for each converter—that is, the separate transformer for each phase has been avoided and the three transformers commonly used in this work have been combined in a single piece of apparatus.

Following the common practice there is at each station an air chamber under the line of transformers. The air in the air chamber is put under slight pressure by motor-driven blowers, and is allowed to rise through the transformers in the usual way, for cooling purposes. At several of the stations an air-compressing outfit is provided for furnishing compressed air used in cleaning out electrical

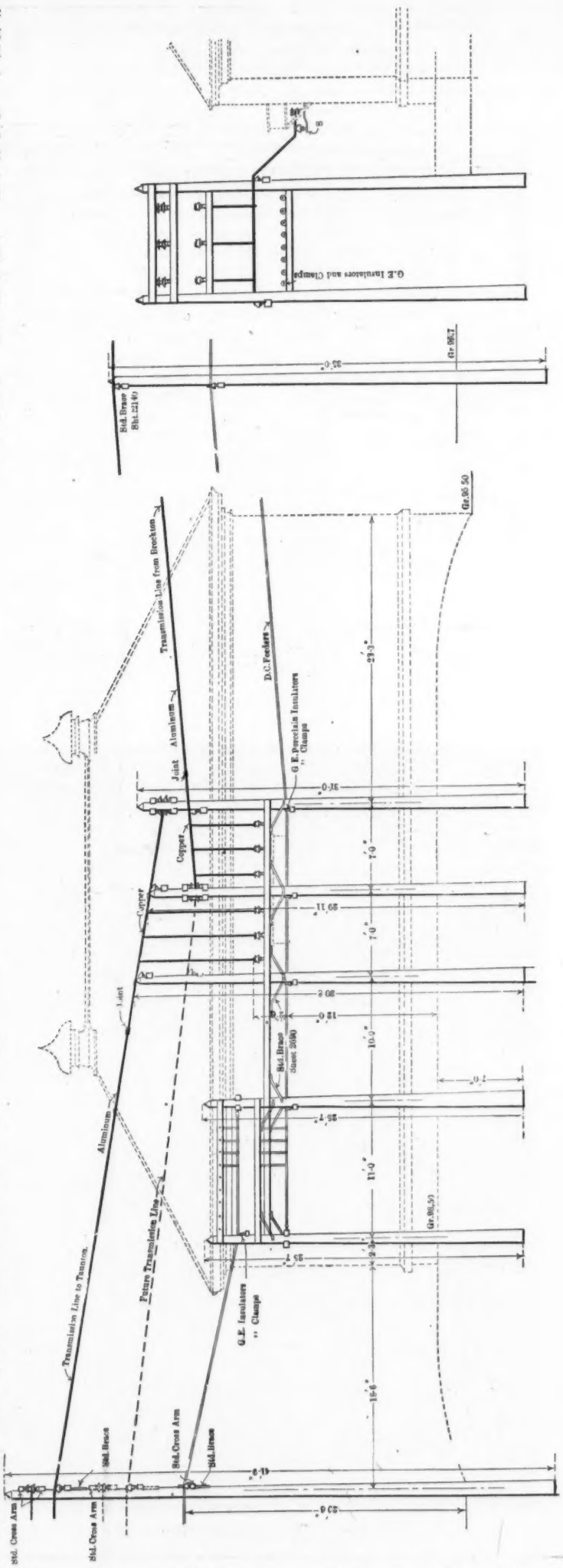


FIG. 7.—TERMINAL POLES ON HIGH-TENSION LINES AT SUB-STATION.

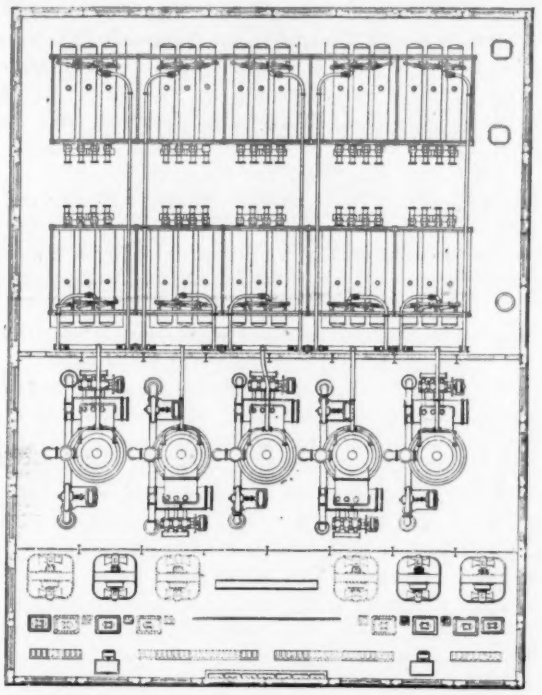


FIG. 8.—GENERAL PLAN, QUINCY POINT POWER STATION.

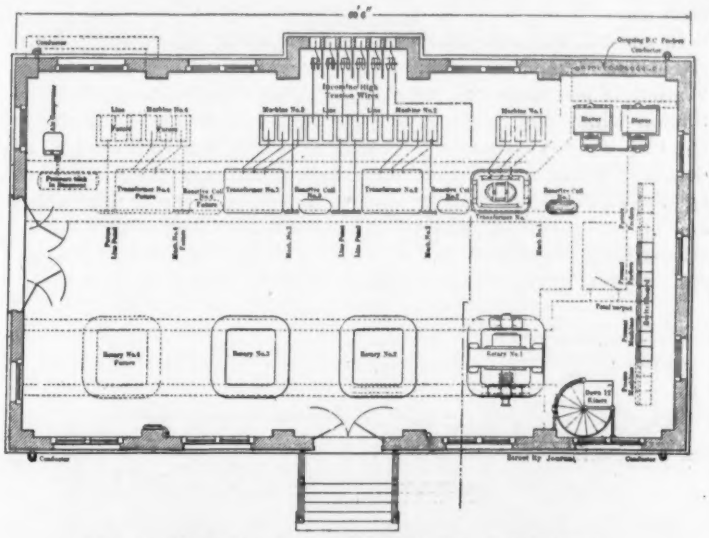


FIG. 11.—GENERAL PLAN, BRIDGEWATER SUB-STATION.

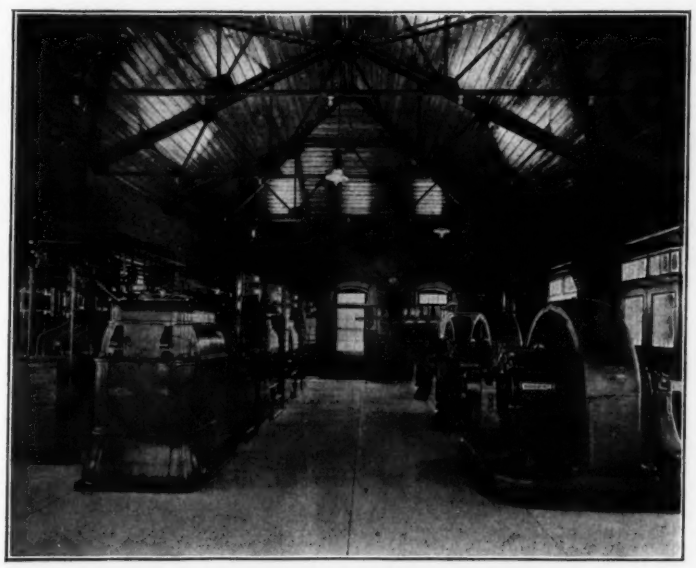


FIG. 9.—INTERIOR OF BRIDGEWATER SUB-STATION.

FIG. 12.—ALTERNATING-CURRENT AND DIRECT-CURRENT SWITCHBOARDS, QUINCY POINT STATION.

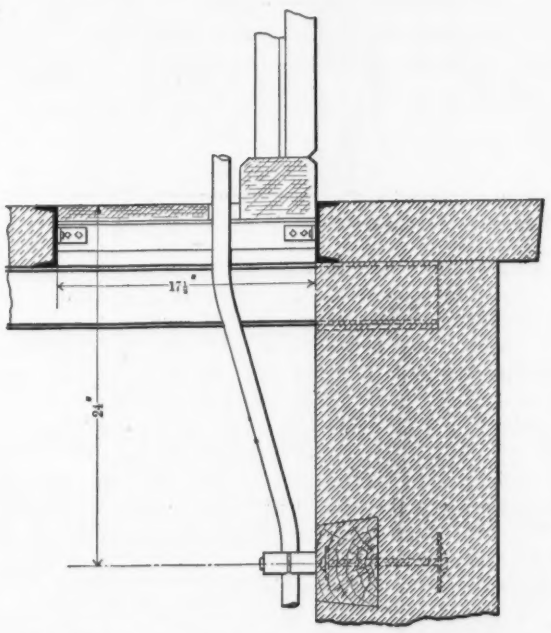


FIG. 10.—METHOD OF RUNNING DIRECT-CURRENT CABLES THROUGH FLOORS.

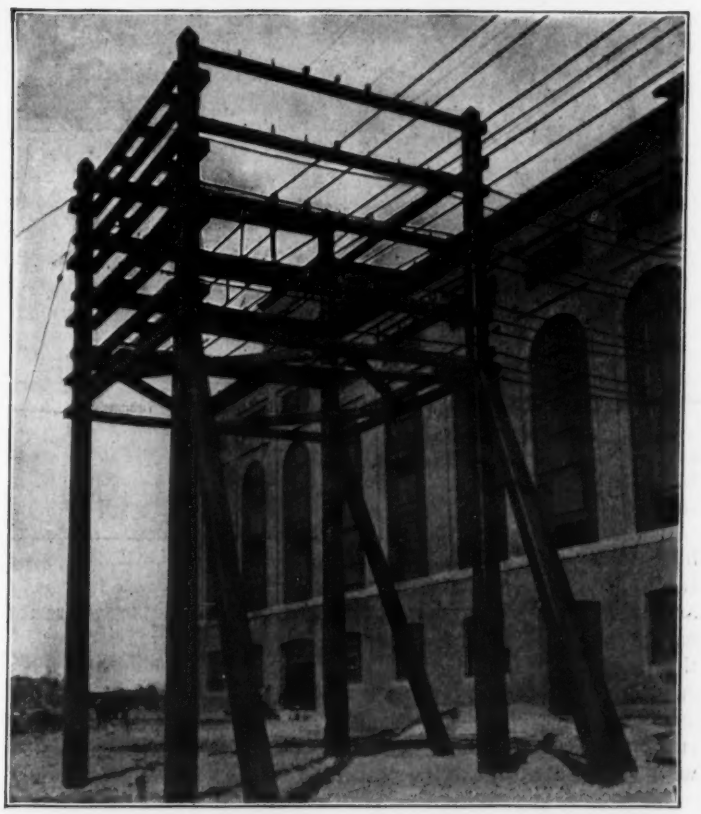


FIG. 13.—ANCHORAGE POLES, QUINCY POINT STATION.

OLD COLONY RAILWAY POWER PLANT.

apparatus and switchboard. The air compressor is motor-driven in each case.

In general, the sub-stations are plain brick buildings with pitched slate roofs supported on light steel truss girders. Copper canopy ventilators are placed in the peak of the roof to insure good ventilation within the building, and the high-tension wires just before entering the sub-station are brought to special pole anchorages, the details of which are set forth in the drawings. From the pole anchorage the wires pass on a slight downward angle directly to the building anchorage on the outside wall of the station. The details of this arrangement are interesting. In the first place the entrance anchorage and openings are protected from the weather by a box or hood carried on a wrought-iron shelf projecting about 2 ft. from the wall and held in place by wrought-iron angle-iron straps in the manner indicated. Each wire from the pole is attached first to a heavy porcelain strain insulator carried on a bracket from the side wall just under the shelf before mentioned. This insulator, of course, forms the main anchorage, and takes whatever outward stress there may be. From this the wire passes immediately to a second strain insulator upon which it is anchored. From a point between the two insulators the tap rises, passes into the box through a wall insulator in the shelf, turns and enters the building through an opening in the wall, which, as before stated, is protected by the box. Within the wall the wires pass over petticoat insulators and then turn down to the lightning arresters, all of which are mounted on the inside wall just below the point at which the wires enter. The arresters are carried on insulators mounted on wooden blocks let into the side wall.

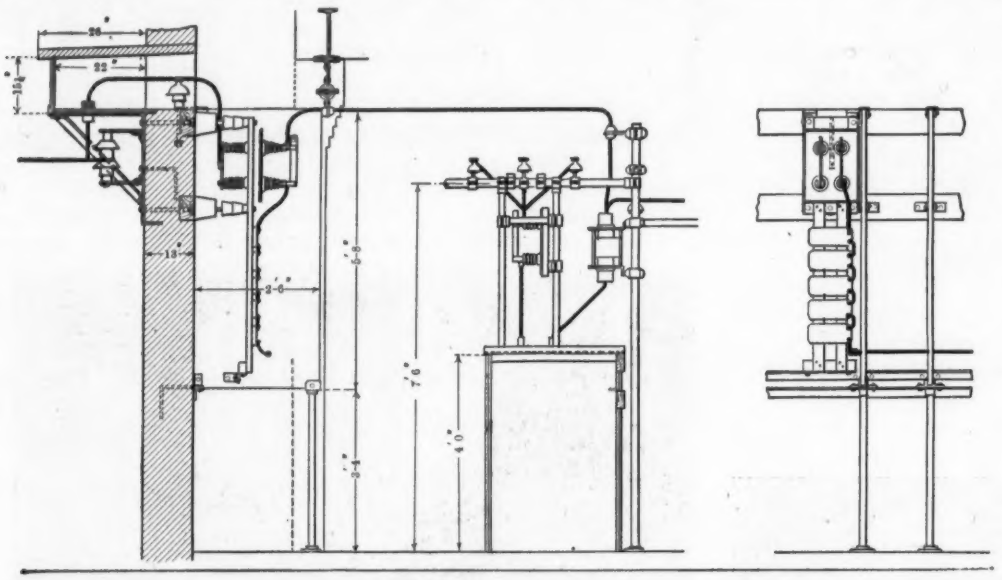


FIG. 14.—DETAIL OF LIGHTNING ARRESTER AND HIGH-TENSION WIRING, BRIDGEWATER SUB-STATION.

In the sub-station design an effort has been made to reduce the high-tension wiring within the stations, and the runs of high-tension cables have been made as short as possible. Wherever it could be arranged, wires are brought into the station at one side, where they pass by a short run to the transformers, then through underground tile conduits acoss the station to the rotaries, then to the direct-current switchboard and out at the other side of the station so as to avoid, wherever possible, the crossing of high-tension and direct-current cables. The direct-current feeders within the building, and where they pass through the walls, are carried in wrought-iron pipes.

Modifications of this arrangement were, of course, necessary at certain points, but the typical arrangement will be understood from the accompanying drawings illustrating the Bridgewater sub-station.

There are two 13,200-volt transmission lines running out of Quincy Point. One of these extends south to Fall River, and serves the sub-stations at Brockton, Bridgewater, Taunton and Fall River. The second line serves the sub-station at Rockland, and is then tied in with the station in Brockton. The transmission wires are strengthened aluminum cables, equivalent to 262,000 circular mil capacity. On straight lines the wires are carried on 35-ft. poles, and the three phases are carried flat on the pole tops, except where there are two circuits on the same pole line, in which case the circuits are connected in double delta. The entire pole line is installed with Locke porcelain insulators. The cross arms are 4-in. by 6-in. hard pine, and are attached to the poles by two ⅝-in. bolts, which pass through the arm and the pole, the opposite side of the pole being bored to receive the bolt heads. The arms are braced by 2-in. by 2-in. by ¼-in. angle-iron braces, fastened to the pole by two ½-in. by 4-in. lag screws, and to the under side of the arms by double ½-in. bolts. On angle construction heavier poles are put in and the angle poles have double cross arms thoroughly braced.

Inasmuch as it was necessary to run the transmission lines through several municipalities, it was thought best to carry the high-tension cables underground through thickly populated districts. At each point where the line enters or leaves the underground conduits there has been erected a terminal house in which are located disconnecting switches, lightning arresters, etc. The design of these houses will be understood from the drawings of the Fall River house, which is typical of the others. The house consists of a brick building 15 ft. by 11 ft. and 16 ft. high, resting on stone pedestal foundations. There is no combustible material used in the construction. The floor consists of 4 in. of concrete, reinforced by 6-in. I-beams and sheets of expanded metal. The roof is also of concrete cement, strengthened with expanded metal and covered with a top coating of tar and gravel roofing. Special provision is made for ventilating the interior. Air is drawn in through ventilator vents near the floor level and passes out through a copper hood ventilator in the roof.

Underground the high-tension current is carried on a three-conductor, lead-covered cable in vitrified conduits. At a point near the terminal house the cable leaves the conduit and is brought up through the floor of the house in wrought-iron pipe conduits to the cable bell, which is located close to the inside wall about 3 ft. above the floor. From the bell the cable fans into the individual phase conductors and the three wires for each circuit are then continued straight up the inside walls to the disconnecting switches located on the wall near the roof. From the switches the wires rise and are carried across to the opposite wall, where the taps are taken off to the lightning arresters located on this wall, as will be understood from the drawings. The main wires pass straight out through the wall at a point just under the roof, and then pass to the pole lines through the medium of special strain insulator anchorages.

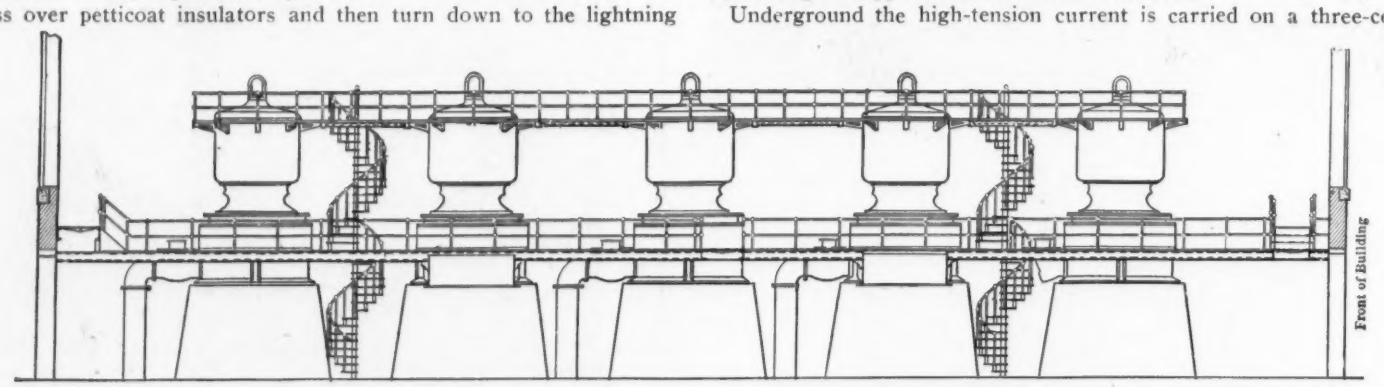


FIG. 15.—LONGITUDINAL ELEVATION OF TURBINE PLATFORMS.

Papers Presented at the Denver Meeting of the National Electric Light Association.

Below are given abstracts of the greater number of papers presented this week at the Denver meeting of the National Electric Light Association. Abstracts of the remaining papers on the programme will appear next week, together with abstracts of the discussions on all papers and an account of all other proceedings of the meeting. On another page will be found a telegraphic report of the first sessions of the convention.

AUTOMATIC SYNCHRONIZING OF GENERATORS AND ROTARIES. BY PAUL MACGAHAN.

The first improvement in synchronizing devices over the well-known phasing lamps was found in the "synchroscope," an instrument that rotated a pointer in synchronism with the difference in speeds of the machines. This instrument, which is made by the Westinghouse Electric & Manufacturing Company and has been described in these columns, gives perfect indications of the phase relation between the machines at any instant and whether the speed of the incoming machine is too slow or too fast. It does not, however, make allowance for the time required to close the coupling switch. One of the best known of the early attempts at producing an automatic coupling device was embodied in the Pearson synchronizer. This device consisted of two controlling magnets mounted in the same case. One magnet was equipped with a time element which allowed it to close its contact when the difference in speed was small enough, and the other magnet would complete the switch-closing circuit when the machines were in exact synchronism. The author described in detail the new Westinghouse auto-synchronizer, which was briefly outlined on page 812 of the issue of this paper for April 29, 1905, and stated that it is no longer an experimental device, but an assured success and a great advance in the handling of alternating-current generators and rotaries. In discussing the application of the device he remarked that an automatic synchronizer would be particularly desirable in the operation of large electric railway systems. When accidents occur which entirely shut down one or all substations it is exceedingly important to be able to start up with the least possible delay, and there has been considerable discussion lately as to the best means of starting up the rotaries. If they are started directly from the alternating-current side, only a small number can be started at once; otherwise there will be too much inductive load on the generating station. This method, therefore, requires considerable time. Starting from the direct-current side presupposes the presence of direct-current power and necessitates a preliminary adjustment of the rheostats. However, if alternating-current starting motors are used and an automatic synchronizer is installed for each rotary, in order to start the substations it would only be necessary to throw in all the starting motors as quickly as possible and leave the rest to the automatic synchronizers, no further attention being necessary.

MERCURY ARC RECTIFIERS. BY P. D. WAGONER.

After discussing the various devices now available for charging storage batteries by power obtained from alternating-current sources, the author described in detail the General Electric type of mecury arc rectifier. (See the issue of this paper for June, 1905.) It is stated that the only part of the rectifier set that can require renewal is the tube and that the life of the tube under normal operating conditions is at least 400 hours, while some tubes have operated for 3,000 hours. It is shown by means of calculation based on service conditions that the saving in cost of energy due to the higher efficiency of the rectifier set over a motor-generator set is sufficient to pay for a new tube in about 124 hours. The mercury arc rectifier makes possible the operation of the magnetic lamp from the well-known constant-current transformer on alternating current circuits. Such a system of street lighting has been operated by a central station for some time with remarkably satisfactory results.

THE NERNST LAMP—ITS PRESENT PERFORMANCE AND COMMERCIAL STATUS. BY E. R. ROBERTS.

The paper presented the results of a series of life and photometric tests of Nernst lamps recently made by the manufacturers. The method of making the tests and the photometer used were fully described. During the life test the lamps were operated under what is considered good maintenance conditions, the globes and holders being cleaned every 200 hours. The decrease in mean hemispherical candle-power amounted in 1,000 hours to 22 per cent, the greater part of which took place in the first 300 hours. The initial consumption per mean spherical cp was 3.31 watts and per mean hemispherical cp was 1.95 watts. At the end of 1,000 hours the values had increased to 3.78 and 2.27, respectively. It is stated that, while the Nernst lamp properly belongs to the class of incandescent lamps, from the maintenance standpoint it is more akin to the arc. From the reports of the 7,000 glower units in service in the Pittsburg district it is learned that the total maintenance cost per glower per month is 9.56 cents, and it is estimated that the cost for maintenance per kw-hour of energy used is 5.2 mills. This figure agrees closely with the average cost reported by a number of companies who use the lamp on a large scale.

SIGN AND DECORATIVE LIGHTING. BY LARUE VREDENBURG.

The author dealt with the subject from its purely commercial side. One thing that has acted as a decided handicap to the introduction of electric signs in many cities and towns is the restriction placed by ordinance on the size and position of signs. In many cases they are prohibited from projecting more than two feet from the building line. In general, these ordinances were enacted before the value of electric signs to the municipality itself was fully realized. A little properly directed effort on the part of the lighting companies will undoubtedly tend to the correction of this condition, as the benefit accruing to any town from the added illumination of its streets by means of signs is so self-evident that but little argument is necessary. The method pursued by one of the large companies last year was a persistent and systematic advertising campaign by means of letters, return postal cards and enclosed stamped envelopes, sent to a selected mailing list including all retail merchants in all lines of business whose stores were sufficiently pretentious to possess plate-glass windows. This campaign last year resulted in more than doubling the number of sign customers. The above result was obtained in a city where an ordinance restricts the projection of signs to two feet from the sidewalk line. Consequently, most of the signs installed are placed either vertical or flat against the face of the building. Most of the large companies use electric signs for their own advertising, thus proving their faith in what they recommend to others; the effect of this is undoubtedly in the right direction. A field that shows quite a promising crop for lighting companies is the illumination of bill-boards. These are generally controlled by advertising concerns, who are beginning to appreciate the increased value of their space when properly illuminated. This is also appreciated by the advertisers, for they realize that the illumination of a sign-board adds about five hours each day to its usefulness, and they are willing to pay for these five hours. Some of the lighting companies whose lines extend through country districts in reaching suburban towns are beginning to light the large bill-boards displayed along railroads and highways. This should be profitable lighting wherever the boards are within a reasonable distance of the company's lines. Another type of sign which appeals strongly to the general advertiser is the so-called "talking sign." This sign, although quite expensive to install and adapted to use in only the larger cities, is of such versatility and attractiveness, enabling the user to present such varied and extended arguments, that it should prove a profitable investment.

FREE SIGNS AND FLAT RATES. BY C. W. LEE.

The writer considered only that phase of the subject which relates to the possibilities presented in the use of the electric sign as a means of obtaining long-hour customers. The meter has been a formidable obstacle in the upbuilding of the sign business. In most cities and towns the early closing movement is in vogue, and this makes the flat rate welcome, as many merchants are obliged to leave their signs and windows in darkness rather than go to the expense of employing a watchman to cut their lights out at a certain hour. The flat rate has a particularly good effect on sign lighting, as it insures use of the sign six or even seven nights a week, while those operated on a meter basis are used only the nights when the store is open, which is the time when there already exists a large demand for the current.

With a view to further increasing the sign business this company with which the author is connected has recently placed in operation a plan whereby the greater portion of its sign lighting will be entirely removed from its peak during the months when the peak must

be considered. Free signs on a flat rate for certain stipulated hours each night are the nucleus of this plan. The time of switching on is placed about half an hour after the peak load. The turning on and off of signs is controlled by patrolmen, who not only attend to these duties but inspect all signs as well as solicit new business. It is expected that as soon as this plan is under full headway the increased business will necessitate the running of special sign circuits from the station. In this event the expense of patrolmen would be eliminated. Isolated signs at some distance from the main streets are controlled by time-switches. Before the adoption of this flat-rate schedule it was argued that no customer would be willing to contract for a sign that could not be turned on during the first half-hour of darkness, but experience has proven that this question is waived in many instances, the specific rate overshadowing this point. To the customer who desires the other method the meter is always available. Again, this flat rate has been the means of stimulating a large amount of sign business away from the heart of the retail district. It finds favor with the neighborhood stores and with business places on back streets. Further, it has demonstrated the fact that an electric sign as an advertising medium is a pronounced stimulus to trade in the outlying districts.

SERIES ALTERNATING-CURRENT MOTORS FOR INDUSTRIAL WORK. BY CLARENCE RENSHAW.

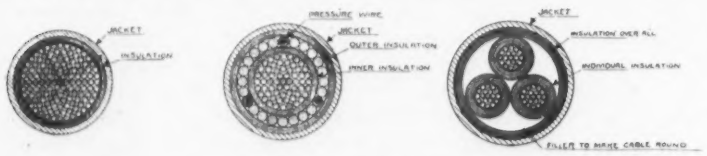
After discussing the constant speed characteristics of the induction motor and outlining the conditions under which a motor possessing the speed-torque characteristics of the direct-current series is required, the author described a type of series alternating-current motor for both 25 and 60-cycle circuits which the Westinghouse Electric & Manufacturing Company has developed and placed on the market for industrial service. The motor is of the commutator type and is provided with an auxiliary field winding which is placed in slots in the pole pieces. The machine is a compensated motor similar in performance to the alternating-current railway motor which has previously been described in these columns.

SOME INVESTIGATIONS OF INDUCTION LOSSES. BY E. P. DILLON.

The article deals with the detrimental effect of the wattless component of the current in a supply system. After having mentioned the causes for the wattless current, the author determines the losses in a line having certain assumed constants and expresses the results in electromotive force, energy and dollars. It is suggested that synchronous motors may be caused to introduce leading wattless currents by overexcitation of their fields, and thus may be employed to neutralize the wattless currents in the system. The kilovolt-amp. rating of the synchronous motor for such work is calculated for assumed conditions. It is stated that the most prolific source of low-power factor (wattless current) is due to the use of induction motors which are operated at less than one-half of the rated load. A remedy would be found in embodying in contracts a clause specifying that the motors installed shall have rated capacities within a certain percentage of their individual loads.

THE CHOICE OF AN INSULATED CABLE. BY WALLACE S. CLARK.

The size of the conductor is determined by well-known thermal and economical laws in most cable installations. It is important, however, that for underground construction there be not used cables so small as to be mechanically weak. There is given a diagram showing the variation in cost per 1,000 circular mils of copper contained in the cable for different sizes of cables and different working e.m.f's, from



THREE CABLE SECTIONS.

which it is seen that, with a 15,000-volt cable, changing the size from No. 8 to No. 6 increases the cost less than 4 per cent, while the conductivity is increased 58 per cent. As to whether single or multiple-conductor cable should be used, it may be stated that for station wiring single conductors in separate ducts might safely be taken as the best modern practice, while for outside lines the determining factor will be the nature of the service. For low tension mains on the three-wire system the three-conductor cable is slightly cheaper than three single-conductor cable, but not nearly as convenient for making taps to customers. For low-tension feeders, which usually exceed 250,000 circular mils in size, the concentric type of cable should be used for maximum duct economy. Smaller cables may be run as a flat twin conductor. For three-phase work, three-conductor cables, and for two-phase, four-conductor cables are required, on both economic and engineering grounds. The paper advocated a type of insulation now used by the General Electric Company which was claimed to possess all of the good qualities of paper, to be more flexible, to have a considerably higher dielectric strength, and which does not absorb moisture and can be used in interior work. These advantages are stated to be found in varnish and cambric, which will not deteriorate under temperatures destructive to rubber insulation.

APPARATUS AND METHODS—INSULATION TESTING. BY C. F. SKINNER.

The writer discussed briefly the elements that should be considered in the design, selection and use of apparatus for making dielectric tests. In high-tension transmission work the testing voltage is usually from one and one-half to two times the normal rated e.m.f. of the apparatus. Tests of 100,000 to 150,000 volts will cover any commercial work, and 250,000 volts should be sufficient for any investigation in connection with commercial work. Testing apparatus capable of giving half a million volts is merely a scientific curiosity at the present time. The author gives a table showing the relative ratings of testing transformers, from which it is noted that for maximum testing e.m.f's above 30,000 volts the current rating should be one ampere and for lower e.m.f's the rating should be two amperes. Due to the charging current of a piece of apparatus considered as a condenser, for a given condition of test a larger testing transformer will be required for high than for low frequencies. It is stated that each of the 5,000-hp generators for the Niagara Falls Power Company has a capacity of about 0.3 micro-farad, and the capacity of each of the 5,000-kw generators of the Interborough Rapid Transit Company is 0.6 micro-farad. The size of the transformer for supplying the charging power for the former machine at 25 cycles and 6,000 volts is 1.7 kw, while that for the latter machine at the same frequency and 25,000 volts is 50 kw.

The three principal methods of varying the testing voltage when making dielectric tests are: (*a*) by varying the field strength of the generator; (*b*) by means of a resistance in series with either the primary or the secondary circuit of the testing transformer, or (*c*) by bringing out loops from the high-tension side of the testing transformer, with further combinations of the low-tension windings. The last method is by far the most satisfactory. There are given numerous diagrams showing such arrangements suitable for both low and high-voltage testing.

The author states that in the measurement of the testing voltage the method involving the use of the spark-gap has many disadvantages and few advantages. The voltage measurements are very unreliable unless an elaborate set of shields is used, and there is much controversy as to the actual distances which represent given voltages. A more satisfactory method is by the use of a voltmeter transformer. This method is very expensive with very high voltages for the reason that the voltmeter transformer is very difficult to wind and insulate for such small outputs.

It is good practice in manufacturing work to test each part as it is finished, as well as the completed apparatus, in order that any defective workmanship or material may be discovered before the parts are finally assembled, and it is customary to grade the test voltages from higher to lower values as the apparatus nears completion. The paper is illustrated with a number of views of Westinghouse testing and regulating transformer outfits and by diagrams of connections.

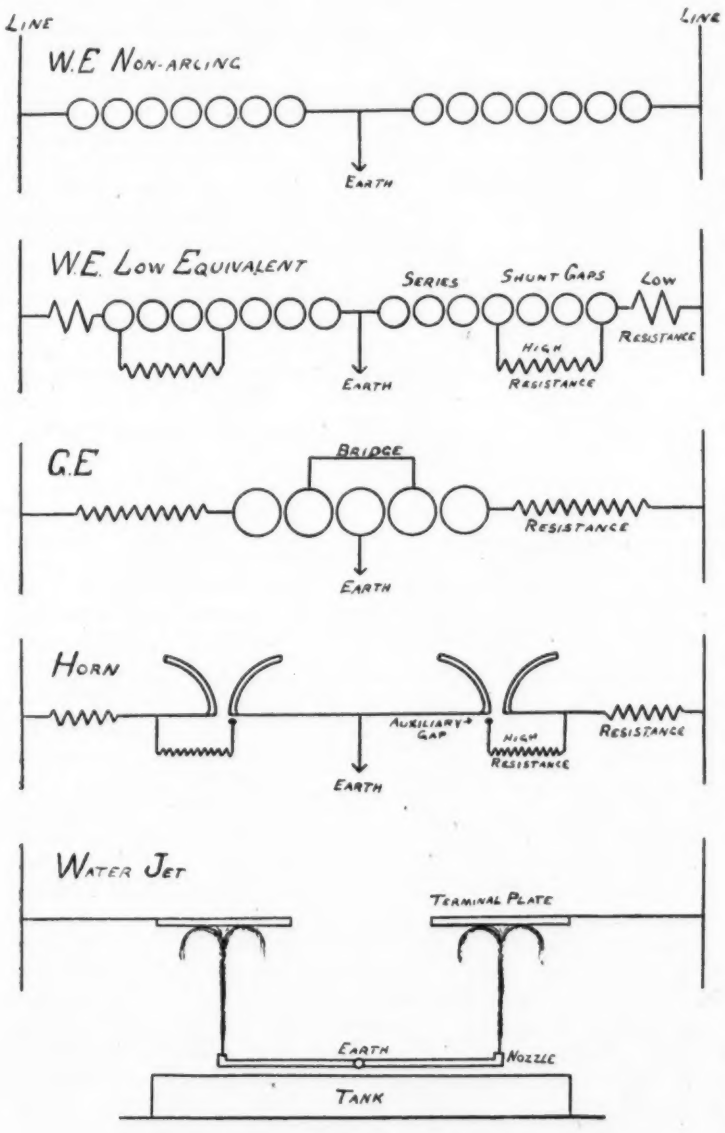
THE PARAMOUNT IMPORTANCE OF THE SELECTION OF STANDARD INSTEAD OF SPECIAL MACHINERY. BY DAVID HALL.

The paper refers to "standard machinery" as machinery that is regularly listed for sale by a reputable company, such machinery having been built and standardized. The author, who is connected with one of the large manufacturing companies, points out the advantages to the purchaser of specifying standard machines on account of the promptness of delivery and the cheapness of the product. The purchaser should act as a judge and not as a designer. The purchaser, in making inquiries for machinery, should state the necessary requirements, but should carefully avoid the addition of unnecessary requests. If the specifications are so drawn the manufacturer can

offer the purchaser standard machinery with guarantees, and the price may be considerably lower than if the purchaser had filled his specifications with a number of unnecessary conditions. Let the purchaser define the work to be done, and let the manufacturer prescribe the machine to do it.

REPORT ON PRESENT METHODS OF PROTECTION FROM LIGHTNING AND OTHER STATIC DISTURBANCES. BY ALEX DOW.

This report forms a brief review of present practice and does not attempt to give any new theories or to describe any untried devices. It is the function of the lightning arresters to protect the apparatus used in transmission lines from lightning, from high-frequency waves set up by sudden changes of load or by resonance, and from static charges. The essential features of protective apparatus are as follows: (1) They should discharge at a potential slightly higher than that of the system. (2) The ordinary working of the system should



LIGHTNING ARRESTER DIAGRAMS.

not be affected by the discharge. (3) The electric energy of the static disturbance should be dissipated as rapidly as possible. (4) The static waves should be prevented from developing high-potential differences in generators, transformers and other apparatus. Among the various devices used for protection the author describes the General Electric arrester for 2,000 volts, the Westinghouse arrester for 2,000 volts, the Westinghouse low-equivalent arrester, the horn arrester, and the water-jet arrester for alternating-current systems, and describes the Thomson magnetic blow-out arrester, the Westinghouse direct-current arrester, the Garton arrester and the Westinghouse tank arrester for direct-current systems. He concludes that there is still much to be done before it can be claimed that the lines are perfectly protected. The engineers of the manufacturing companies have developed apparatus that operates successfully under ordinary conditions, but each transmission line presents a separate problem which can be solved only empirically.

A NEW TYPE OF SINGLE-PHASE, ALTERNATING-CURRENT MOTOR FOR ELEVATOR WORK. BY S. PERCY COLE.

After having outlined the advantages of operating elevators by electric motors and having pointed out the limitations of the polyphase induction motor, the author described a type of motor which affords practically all of the desirable characteristics of the direct-current elevator motor. This motor, which is the invention of Mr. Leo Schuler, an electrical engineer of Frankfort, Germany, and made by the Wagner Electric Company, of St. Louis, has been described in these columns. In construction it is a combination of the repulsion and induction forms of single-phase motors. Mechanically, the motor consists of an ordinary induction motor frame. It has an ordinary induction motor stator core, built up of laminated sheet steel. The stator winding consists of form-wound coils, distributed in slots around the inner periphery of the stator core. The motor is built up of laminated steel in the same way as the stator, and carries a progressive wave winding similar to the usual direct-current armature; on one side is provided a commutator and on the other side three collector rings connected into the winding in polyphase relation. In operation the first effort of rotation is secured with connections corresponding to the well-known repulsion motor. After the armature has attained about one-quarter speed the polyphase resistance, connected to the armature through the slip rings, is thrown in and gradually short-circuited as the armature runs up to full speed. The brushes bearing on the commutator in the usual elevator equipment are not completely short-circuited, but have a fixed resistance interposed between them; at no time are the brushes removed from the commutator. An outfit which has been in service for six months has operated with extremely satisfactory results. The sparking is practically *nil*, and the life of the commutator is predicted to be equal to that of the best direct-current elevator motors.

REPORT OF THE COMMITTEE ON PROGRESS. BY T. C. MARTIN.

After giving numerous statistics of the industry showing developments abroad and in America, the report takes up the subject of illuminants. Descriptions are given of impregnated carbon arc lamps, mercury vapor arc lamps, tantalum filament incandescent lamps, the osmium and the cadmium lamps. In discussing the unexploited fields for the use of electric power, the author drew attention to the advantages to the central station of acquiring a refrigerating power load, and stated that wherever power can be furnished at a rate less than 5 cents per kw-hour automatic refrigeration by means of apparatus now available effects a large saving over the cost of ice, even if the manifest advantages of cleanliness and convenience of operation be not considered.

LONG-DISTANCE, HIGH-TENSION TRANSMISSION IN CALIFORNIA. BY JOHN A. BRITTON.

The paper gave a résumé of what has been accomplished in the past ten years in the developments of the electric transmission systems now under the control of the California Gas & Electric Corporation. The paper describes both the old and the new arrangements employed in the power stations and in the transmission lines, thus indicating the arrangements which have best withstood the test of service.

THE ORGANIZATION OF WORKING FORCES IN LARGE POWER HOUSES. BY W. P. HANCOCK.

The author gives a diagram showing the organization of the generating system of the Boston Edison Company, which has in service a total of 172 men. The specific duties and responsibilities of each man or group of men are outlined. It is stated to be the policy of the company to show every employe that his position has a value both to the company and to himself; to show that the value of the position to the employe was what the employe himself could make it, aided by the counsel and instruction of the superior who had his services in immediate charge, and by paying a uniform rate of wage for a uniform quality and quantity of labor in every line, the company had adopted a treatment of its men conducive to contentment and was reasonable in assuming and expecting it.

REPORT ON PURCHASED ELECTRIC POWER IN FACTORIES. BY E. W. LLOYD.

The report contains a compilation of valuable data connected with the electric power loads on the central stations belonging to the association. In discussing the question as to whether a factory should run from central station service or whether it should generate its own power, the author stated that the decision is not always governed by the rate per kw-hour which the central station company proposes to charge for the power. To any one who has had experience with installations of motors driving machinery where one large motor was used, it is known that no economy can be obtained over engine drive with profitable rates for central station service. It may be possible with the use of a few motors in a large plant running 15 to 24 hours a day with a low rate per kilowatt-hour, that central station power can compete with engine drive; but the average plant does not run more than ten hours a day, and, therefore, the rates of a central station company doing a profitable business cannot compete successfully with these conditions. It is, therefore, necessary to consider other sides of the factory power subject than merely the question of price per kilowatt-hour. While it is true that the installation of individual motors increases the connected horse-power load in a given factory over and above what it would be should group-drive installation be made, it is also true that the energy consumption is considerably less on the individual motor installation. There are engineers throughout the country who advocate individual motor installation, but the subject has not received the proper consideration from all central station companies, and the sooner it is brought forcibly to their attention that this type of installation will do more to increase their power load than any other one thing, the more universal the practice will become. The selling by some companies of electric power at very low rates even to the extent of losing money on this power is not necessary with proper motor installations. Extremely low prices for electric power in some localities are detrimental to the station business in others, and they are not necessary if the proper attention is given to the engineering features in obtaining power business.

Character of Installations.	Average kw.-hours per month.	Average connected motor load, hp.	Individual or group drive.	Average number of motors.	Percentage of average load to connected motor load.	Total number of installations.
Bakeries	1582	32.8	Group	2.7	27.8	17.
Bakeries	705.3	22.5	Individual	3.1	19.5	8.
Boiler shops	326.7	51.4	G	2.8	33.3	11.
Boiler shops	1172	32.2	I	5.2	20.7	5.
Boots and shoes	3050	39.7	G	5.8	42.8	13.
Box making	1555	18.1	G	4.3	45.4	20.
Blacksmiths	586	9.4	G	2.2	34.2	12.
Brass finishing	5736	40.5	G	7.4	45.0	9.
Butchers and packers	1990	24.8	G	2.0	36.4	13.
Butchers and packers	1049	36.9	I	6.7	18.8	10.
Breweries	12310	94.0	G	4.6	33.0	8.
Carpet cleaning	644	14.5	G	1.6	30.1	12.
Cement mixing	2009	37.5	G	1.0	24.9	4.
Candy manufactory	1893	26.6	G	3.5	33.6	10.
Candy manufactory	796	29.9	I	7.5	16.3	8.
Cotton mills	11829	99.0	G	3.0	60.1	3.
Carriage works	2091	24.8	G	3.5	35.5	22.
Chemical works	4802	109.	G	5.5	23.5	6.
Clothing manufacturing	1181	23.	G	4.0	44.5	33.
Grain elevators	3842	114.4	G & I	3.8	32.6	19.
Feather cleaners	2447	54.4	G & I	5.5	25.7	2.
General manufacturing	6133	67.5	G & I	6.4	33.9	181.
Engrv. and electrotyping	863	12.4	G	2.5	46.9	8.
Engrv. and electrotyping	2369	46.3	I	26.7	22.5	7.
Glass grinding	2760	33.5	G	3.0	36.6	6.
Foundries	2057	27.7	G	2.3	43.7	15.
Foundries	2419	81.1	I	7.0	21.3	18.
Furniture manufacturing	1750	35.7	G	3.6	35.6	9.
Flour mills	41276	148.5	G	3.1	48.1	13.
Hoisting and conveying	2905	70.5	G	6.4	28.3	5.
Hoisting and conveying	6562	253.	I	20.0	13.0	9.
Ice cream	596	31.	G & I	5.4	35.9	7.
Refrigeration	4645	36.7	G & I	2.5	53.4	17.
Jewelry manufacturing	2526	31.7	G	4.6	31.6	5.
Laundries	676	10.8	G	2.1	34.0	19.
Marble finishing	1464	19.8	G & I	1.3	51.3	12.
Machine shops	4006	57.6	G	4.5	34.5	51.
Newspapers	3150	47.4	G	4.8	38.0	24.
Newspapers	4975	137.0	I	17.3	15.1	21.
Ornamental iron works	2771	38.4	G	3.6	41.6	9.
Paint manufacturing	2814	60.4	G & I	4.6	26.5	11.
Printers and bookbinders	1147	20.4	G	2.6	39.5	54.
Printers and bookbinders	6215	76.8	I	24.0	26.0	39.
Plumbing, manufacturing	3020	42.4	G	4.8	21.5	15.
Rubber manufacturing	1051	26.0	G & I	15.	24.7	2.
Sheet metal manufacturing	1321	38.8	G	3.7	27.3	17.
Soap manufacturing	3434	73.0	G	10.0	27.6	2.
Seeds	2917	55.1	G & I	5.8	24.4	5.
Structural steel	6514	176.0	I	16.1	18.5	6.
Structural steel	77704	552.1	G	35.6	31.1	6.
Stone cutting	7425	76.5	G & I	3.8	34.4	20.
Tanners	2466	28.6	G	2.6	54.6	5.
Tobacco working	3441	62.3	G	7.0	37.5	4.
Wholesale groceries	2005	47.0	G & I	4.5	26.0	17.
Wood working	2306	39.5	G & I	3.6	33.3	64.
Woolen mills	20985	150.	G	3.0	71.0	1.
Averages	3500			6.08	33.9	951.

Factory managers are appreciating more and more every day the advantages of electric drive, and it is not nearly so hard a job to induce them to-day to change over to motor drive as it was a few years ago when there were comparatively few large plants in the country equipped in this way. In equipping a factory with motors it is also necessary to use a fairly efficient motor. If poorly-designed motors are used there can be a great loss of power in the motors themselves, and while it is true that manufacturers are making the average motor more efficient to-day than ever before, it is well to consider the matter of efficiency and see that the motors to be used are of a good make. This point is not always given proper consideration by the central station agent or the factory owner. Very frequently the factory owner has some friend in the motor business who induces him to use motors that are not as efficient as they should be.

It is worthy of note that there are yet some lines of business to which the central station furnish little or no power. As the selling of power from central station service is still in its infancy, this is not surprising; in fact, it is more surprising that the central station companies have obtained such large power loads in so few years. Experience in some lines would indicate that it will be necessary to give better rates on these classes of business than on others, in order to increase the central station loads in that direction. On machinery such as large blowers, refrigerating machinery, air compressors, running ten hours or more, or any other machines that have a very high average load during their period of operation, the price per kilowatt-hour must necessarily be less than for machines such as punches, lathes or other tools, where, no matter how continuously they are operated, the average load is only a small part of the maximum load.

The table above is made up as showing the average load as indicated by the figures submitted by companies doing business in cities in all parts of the country, and while it was not possible to get as large a number of factories for each class of business as was desirable, the figures show very fair average conditions, and are approximately correct.

OPERATING FEATURES OF VERTICAL CURTIS STEAM TURBINES. BY AUGUST H. KRUESI.

The paper discussed the very considerable experience already had with the Curtis turbines, and numerous suggestions are made as to the installation and operation of these machines. It is comparatively easy to secure such freedom from vibration in all sizes of turbines that a coin will stand on edge at the top of the machine indefinitely, and after having been brought to this condition when first started, the machine will require little further attention on this account. The shaft should run true and the bearing shield should be concentric so that the maximum excentricity will not exceed from .002 in. to .004 in. in turbines from 500 to 5,000 kw capacity, respectively. To eliminate the packing at the lower end of the shaft the step bearing is generally lubricated with water, the shaft being fitted with a bronze sleeve running in a babbitt-lined guide bearing. By the use of a baffler it is possible to operate 500-kw and 5,000-kw turbines from the same pumps and piping system economically and satisfactorily under every condition. The step bearing has shown remarkable sturdiness when subjected to cessation of forced lubrication. To illustrate this a test has been made in which a 500-kw turbine was run up to speed, lubricant and steam turned off simultaneously, the turbine brought to rest due to the friction of the step, and immediately re-started, six times in succession, without difficulty of any kind. After raising the lower bearing plate by means of the adjusting screw to compensate for the wear of the plates, they were just as good for further service as at the beginning, although naturally somewhat grooved. The type of valve mechanism which will ultimately prevail as the simplest and most satisfactory can be determined only by practical experience. With a view to ascertaining the best type, various forms of mechanically and hydraulically-operated valves are under test in service conditions. The mechanically-operated valves derive their motion from the turbine shaft under a fixed period, depending upon the turbine speed and, therefore, have no tendency to accumulate changes in speed or cause hunting. The governor controls the number of valves to be opened or closed by a

modified Corliss release mechanism. The hydraulically-operated valves are positively opened and closed by a cam shaft under the control of a hydraulic cylinder, the piston of which connects with a follow-up attachment which makes it absolutely non-hunting.

After discussing turbine-driven auxiliaries, condensers and steam consumption, the author concludes that the saving in first cost alone between the turbine and engine-driven units is equivalent in fixed charges to a reduction of the water rate. The saving of the condensed steam by the turbine, where feed water must be bought at ordinary city rates, is also considerable, as is that effected by the less attendance necessary for the turbine. All of these considerations, however, are of minor importance as compared with the reduction in steam consumption indicated by various tests, because there is hardly any part of the equipment of a power station whose capital and operating costs cannot also be reduced as a direct result, such as boilers, stack, coal-handling apparatus, condensers, pumps, etc., or, in other words, a reduction of 10 per cent in the water rate of the turbine means a station of 10 per cent greater capacity and output for the same investment, fixed charges and operating expense.

THE TANTALUM INCANDESCENT LAMP. BY DR. LOUIS BELL.

The paper gave an account of the test of some 25-hefner, 110-volt tantalum lamps by the author and Prof. W. L. Puffer, two of the lamps being tested for decay as reported in detail in these columns last week. The light of the tantalum lamp is, as might be expected from its high efficiency, rather whiter than that of an ordinary incandescent, being as white as the Nernst lamp or the acetylene flame. Its distribution of light is in the present form of filament rather less uniform than that of the common incandescent lamp, being relatively more powerful in a horizontal zone and less powerful for points near the axis. The ratio of mean spherical to mean horizontal candle-power as found in Prof. Kennelly's investigation of the frosted lamps, proved to be .73, and Dr. Bell's figure from the clear lamps was substantially the same. The distribution, however, could very easily be improved, so that the spherical reduction factor would not differ materially from the usual figures and the light at the top could be correspondingly increased.

Since the tantalum filament has a low initial resistance (between 55 and 60 ohms) it jumps into incandescence with startling rapidity as compared with a carbon filament, but because of its positive temperature coefficient it seems to be decidedly less sensitive to changes of voltage in its working condition. This is a useful property in certain respects. The fact, however, that the initial resistance of the tantalum is so low and its thermal inertia so small owing to its small mass and low specific heat, means rather violent heating up, which is probably the cause of some doubts which have been expressed as to the endurance of these lamps upon alternating circuits. It is not difficult to imagine pretty severe strains upon the filament if it had time to cool down much between impulses. If such cooling could take place, for instance, on an ordinary alternating circuit, the results might be serious.

Some stroboscopic tests were, therefore, made at the last moment to determine whether at, say, 25 cycles, there was a specially violent fluctuation of light from the tantalum lamp; in other words, to find out whether on a 25-cycle current the filament had time to cool down materially. The result showed that the light fluctuation at this frequency was somewhat but not much more pronounced than in a carbon filament. The tantalum lamp behaved in fact about like a 16-cp carbon filament lamp. Even a 75-cp carbon filament lamp, however, shows perceptible variation under this test. At 60 cycles the fluctuation, while still perceptible, was trivial both in the tantalum and carbon lamps. It hardly seems probable that at 60 cycles the life of the tantalum would be enough impaired to cause serious trouble, but the writer now has some lamps on alternating-current tests and proposes to pursue the inquiry.

The tantalum filament seems to stretch and sag at first as if undergoing annealing and losing the set produced by drawing. Then it shows local bright spots which grow lumpy as if the material tended to flow a little from the heat, and with the increasing lumpiness the filament draws up tight. At this stage it is rather fragile and would probably break easily from vibration or shock. It seems likely that the final break comes just where one of the lumps has reduced the cross-section of the wire beside it. The break in the lamp during test, already referred to, showed considerable attenuation of the loose end.

The lamps as tested showed the following characteristics:

Lamp.	Watts.	C.P.	Watts per candle.
Clear Globes	41.58	21.42	1.94
	38.61	20.90	1.84
	41.58	24.93	1.66
	41.58	21.55	1.93
	41.91	21.81	1.92
	41.91	22.59	1.85
Frosted Globes	40.36	19.79	2.03
	40.34	18.54	2.15
	40.04	18.74	2.13
	40.48	19.27	2.09

The mean result from the clear globes was 22.2 cp at 1.85 watts per cp; that from the frosted globes 19.08 cp at 2.1 watts per candle.

It is interesting to note that the clear lamp gives just about 1 cp per inch of incandescent filament, which implies an intrinsic brilliancy of somewhere about 500 cp per sq. in. of filament—a figure much higher than in the ordinary incandescent.

As illuminants the lamps are certainly very excellent, but their introduction raises some most interesting questions for the central station operator. Putting aside all the petty questions that will be raised about the new lamp for commercial reasons, the broad fact remains that we are here dealing with a bona fide 2-watt lamp having a life fairly comparable with the carbon filament lamps now customarily in use. Moreover, it is a competitor of these, socket by socket, and not as a substitute with particular requirements as in the case of the Nernst lamp, or the very small arcs. There is some doubt as to the life of the tantalum lamp when exposed to unusual vibration, which may perhaps bar it in some special locations, but for the everyday work of the central station there is good reason to believe it generally applicable.

Its price can hardly be said to be fixed in this country, but abroad in Berlin it is about one dollar (4 marks), which will give at least a fair line on its commercial results. On this basis and with power at 10 cents per kw-hour, one finds taking the new lamp on its 600-hour rating that the cost of its 12,000 candle-hours, including the lamp, amounts to $3.40. The same number of candle-hours from a lamp giving a mean efficiency of 3.25 watts per candle would cost $3.90, exclusive of lamps; that is, the consumer could afford to pay $1.00 for the new lamp better than to take the old ones free. With power as low as 5 cents per kw-hour, the user of tantalum lamps could afford to pay only 75 cents per lamp as against getting carbon lamps free. This means that a sliding scale of discounts for lamps according to quality could be made to catch the consumer at all prices ordinarily charged for current by central stations.

Does this mean that the carbon lamp will shortly be down and out? Probably not, for there is no spur like competition to start up improvements, and there are some signs that carbon lamps may be improved enough in efficiency to make things interesting, at least with current at the prices charged to very large consumers. This, however, remains to be seen, and the thing which the central station man has to meet is the immediate probability of consumers putting upon their circuits lamps taking less than two-thirds the watts per candle-power of the best lamps now in use, and thereby cutting down their meter bills enormously. Now, broadly, what shall be the attitude of the central station man toward this income-scalping innovation? There are some managers who may be inclined to put up a fight to discourage the user, either by raising pettifogging objections or by trying to discriminate against 2-watt lamps by readjusting discounts in various ingenious ways. Dr. Bell is very strongly of the opinion that such a policy is wrong and will certainly lead to ultimate disaster in the form of municipal restrictions or regulation of rates by law. In the long run, opposition to improvements does not pay. If, on the other hand, the central station man hangs quietly on and gives the consumer the glad hand, the change will work to his ultimate benefit. In the first place, the tantalum lamps now made are of 22 cp instead of 16, and the filament will hardly bear much reduction in cross-section. The tendency, therefore, will be to use these slightly more powerful lamps taking, say, 42 watts instead of a trifle over 50 watts in the 16-cp carbon lamps. The actual loss in energy sold is likely, therefore, to be for the present quite a little less than the difference of efficiency would indicate.

Besides this, the attraction of cheaper light will certainly bring into line new consumers, so that the net result will probably be an actual increase in sales of current, quite a little of it being among the smaller consumers who pay the higher rates. Such a change means upon the whole more lights connected per unit of capacity in

transformers or feeders, and hence a slightly better utilization of material and improved load. In the case of stations with underground service, the change to 2-watt lamps ought to bring with it increased earnings per unit of cable capacity. The fact is that improvements in the efficiency of utilization of electric energy help the business, and it is both fruitless and inadvisable to oppose them from any short-sighted notion of small temporary savings.

As to the inevitable competition between present lamps and the newcomer, in the first place, the merits of the final issue remain to be determined, and in the second place competition in lamps is, on the whole, a good thing for the user of them, however it turns out. So far as the central station is concerned, it is a case of dog eat dog.

The really important thing is that from now on the station manager will have to deal directly with the 2-watt lamp proposition, for there is no disguising the fact that it is here, and in a form which is quite unexpected. The appearance of tantalum lamps in quantity may be a little delayed in this country, but delay will improve them as in the case of every new product, and will serve to assure a better understanding of their truly remarkable properties and of their possible limitations. The unexpected has certainly happened, for most engineers had long ago abandoned the idea of a lamp with a metallic filament. Only the discovery of a metal virtually new, and possessed of most sensational qualities, could have brought about the present striking result.

LETTER TO THE EDITORS.

Insulation of High-Tension Coils.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with interest Mr. Farrington's article on "Nitric Acid in Insulation of High-Tension Alternator Coils," in your issue of April 22 last.

I do not think the views expressed by Mr. Farrington are correct. The formation of ozone, and of oxide of nitrogen by a brush discharge is a perfectly well-known phenomenon, the atmosphere, of course, being the source of the nitrogen. The gases would not be blown away, as Mr. Farrington suggests, as they are formed inside the tubes next to the copper, and so long as the insulation—which usually consists of cotton braid—is absolutely dry, no damage would be done. Damage is caused as soon as moisture finds its way to the insides of the coils, between the copper and the mica tube, and the heating and cooling of the coils, as I pointed out, causes these partially closed tubes to act as pumps; as the machine increases its temperature, air is forced out of the coils, and as the machine cools down again after it has ceased work, air is brought in. There is no doubt that this trouble is greatly exaggerated in our damp climate. I always find that breakdowns are much more frequent in damp, foggy weather, than in dry weather. It is exceedingly difficult to eliminate the last traces of moisture from insulation; very long drying in vacuo is the only way.

With regard to the presence of nitrate of copper, nitric acid and sulphuric acid, most careful tests were made independently by two experienced chemists, one on the continent and one in London, quite apart from our own tests, and in each case nitrate of copper, free nitric acid and free sulphuric acid were found, the sulphuric acid being formed owing to the presence of gypsum in the braiding.

It is true, of course, that the tube is constructed of mica cemented together with shellac varnish, the tube being most carefully made. If the whole of the trouble were caused through faulty material, as Mr. Farrington suggests, I would ask him why the coils subjected to the highest pressures have the whole of the cotton insulation absolutely destroyed in a period of not more than six weeks, whereas the coils at the earthed end of the machine show no signs of damage? Further, the damage occurs almost entirely in the parts of the coils embraced by the slots. It is at these parts that a heavy green deposit fills up the whole space.

Some action takes place at the ends of the tubes, due, according to my theory, to the escape of free acid. Round the ends of the coils—which are square-ended—at the part most remote from the tube ends, practically no damage has arisen. If Mr. Farrington's theory is correct, coils should be damaged uniformly at whatever part of the armature they are situated, and at any part of the coil.

LONDON, ENGLAND. J. S. HIGHFIELD.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Series Motor.—A full account of the extended discussion which followed Creedy's paper on the single-phase series motor, which was recently abstracted in the Digest. While Creedy thought it possible to design a satisfactory series motor for any frequency not much exceeding 50 periods per second, Schoepf thought that there would be difficulties which could not be overcome in the design of a motor of sufficient capacity for traction work, say 100 hp—at a frequency higher than 25 periods per second. Creedy explained later that when he spoke of a frequency of 50 cycles per second, he was thinking of small crane motors and not of large traction motors. Russell compared Creedy's circular diagram for showing the behavior of the series motor with the diagram of Blondel. Calisch had carried out a considerable number of experiments with a straight series and the compensated series motor. He thought that for practical railway and tramway work only the compensated motor needs to be considered, since the straight series motor has too low a power factor, on account of the high impedance of the armature and field circuits and the poor commutation. Carus Wilson spoke on the question of the power factor, and discussed it from the point of view of the counter volts in the motor. The peculiarity of the alternating-current series motor is that the counter volts consist not merely of those due to the motion in the armature, as in a continuous-current motor, but also of those due to the alternating field. These two are at right angles to one another. Supposing there are the same number of turns on the field and the armature, without any leakage, the two counter volts will be equal at synchronism, and there will be a power factor of 0.7. This at once enables one to understand very clearly and simply what the question of power factor is. It simply depends upon the ratio of the counter volts in the armature due to the motion, and the counter volts in the field due to the frequency. To get high power factor it is necessary to increase the ratio of the two voltages.—Lond. *Elec.*, May 12.

Variable-Speed Motors.—An illustrated description of variable-speed, direct-current motors in which the speed is varied by increasing the air-gap. To this end a hand wheel engages with a screw which, in moving up and down, causes all the field magnet cores to be moved simultaneously in a radial direction toward or from the armature. The standard sizes made by the company which manufactures this type range from ⅓ hp to 110 hp. While the speed of a ⅓-hp motor may be varied between 750 and 2,250 r.p.m., the extreme limits of speed for the 110-hp size are 500 and 1,000 revolutions. Some efficiency curves are given. Within the range from 30 per cent overload and half-normal load the efficiencies vary between a maximum of 92 per cent and a minimum of about 80 per cent.—Lond. *Elec.*, May 19.

LIGHTS AND LIGHTING.

Titanium Arc Lamp.—Some editorial notes with respect to the article of Ladoff, published in ELECTRICAL WORLD AND ENGINEER, April 22, page 757. After giving some data from the article, it is said that although the figures for the titanium arc are extremely good, yet the comparison is not so much in favor of the titanium arc as appears at first sight. "A negative carbon of ½ in. diameter would ordinarily be burned in a 10-amp. arc, and in making a comparison between two rival sources of light, the only fair way is to compare the results when each is burning under the conditions best suited to itself. Thus the carbon pencil at 9.6 amp. had an efficiency of 0.99 watts per candle—its life (which is not given) would be about

two hours per inch—and at the same current the rutile pencil fused too much to burn. Nevertheless, the experiments show that the titanium arc possesses great possibilities which may be developed to an extent that will make it a serious competitor of the carbon arc.—Lond. *Elec.*, May 12.

Meridian Lamp.—An article on a lamp which is intended to fill the gap between the ordinary incandescent lamp and the arc lamp. It is an incandescent lamp having a spherical globe and translucent prismatic reflector. The design is such as to give the light distribution shown in Fig. 1, producing a very good illumination in all

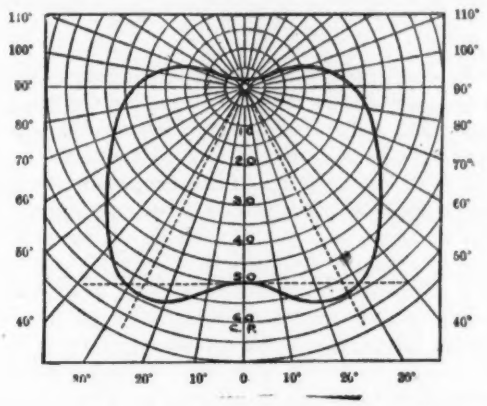


FIG. 1.—CURVE OF LIGHT DISTRIBUTION.

useful directions. The consumption is stated to be 2.2 watts per candle. The lamp is made in only one standard size of 55 cp, consuming 120 watts. It is supplied for all voltages from 100 to 125 and from 200 to 250 volts.—Lond. *Elec.*, May 12.

Carbon Arc in Vacuum.—HOERBURGER.—A long summary on researches on the electric arc between carbon electrodes in the vacuum. A review is given of all the important researches made in this field. The chief points dealt with are as follows: With decreasing pressure the characteristic appearance of the carbon arc changes, three different forms being observed successively. With decreasing pressure of the air or gas from one atmosphere down to vacuum, the voltage at the arc decreases continuously and reaches at 0.1 mm. mercury a certain constant value, which is about 19 volts. For every pressure the voltage at the arc as function of the arc length may be approximately expressed by means of a linear equation, $m + nL$, where L is the length of the arc in millimeters. The value of m decreases with decreasing pressure from 48 volts down to 19 volts. The value n, which is the voltage drop per millimeter within the arc, amounts to 4 volts for higher pressures and remains unchanged as long as form and appearance of the arc remain unchanged; but as soon as the arc itself changes, with lower pressures, the value of n begins to decrease and finally becomes a negligible quantity. The value of m consists of two parts: first, the voltage loss due to the work done at the cathode on account of heating and evaporation of the electrode material, or the work expended for ionization; second, the counter e.m.f. of the arc as the difference of the two thermo-electric forces present at the electrodes and counteracting each other.—*Dingler's Polyt. Jour.*, March 25, April 1, 15, 22.

Mercury Arc.—POLLAK.—An account of measurements of the variation of the potential in the mercury arc. For an e.m.f. at the electrodes of 21.8 volts, a current of 6.1 amp. and a distance of 450 mm. between the electrodes, the voltage drop at the anode (for nickel) was found to be 5.1 volt; the voltage drop at the cathode 4.4 volts; the voltage drop within the mercury vapor itself (represented by approximately a straight line) 12.3 volts.—*Phys. Zeit.*, May 1.

Train Lighting.—DE VALBRENZE.—A continuation of his illustrated description of various systems of electric lighting of railway trains.—*L'Eclairage Elec.*, May 13.

POWER.

Electric Power in Manufacturing Plant.—A fully illustrated description of the new works of the Ingersoll-Sergeant Trolley Company at Phillipsburg, N. J. The power plant contains three 300-kw and one 100-kw, direct-current generators. The general electrical distribution system is two-wire, operating at 240 volts. In addition to this there are two intermediate wires in the machine shops for use in obtaining variable speeds at the motors driving the machine tools. The multiple-voltage system of speed control is in use, and for producing the intermediate voltage there is used a triplicate balancing rotary transformer, consisting of three machines mounted on a common base, and with the armatures on one shaft. The armatures are wound for 40, 80 and 120 volts, respectively. By taking current from each of the three machines, and by combining either two of them, six voltages ranging as follows may be obtained: 40 volts, 80 volts, 120 volts, 160 volts, 200 volts and 240 volts. All tools requiring a large amount of power and used on a variety of work are equipped with individual variable-speed motors.—*Am. Elec.*, May.

Hoisting.—GRADENWITZ.—An illustrated description of an electric hoisting machine for a colliery for raising 105 tons of coal per hour from a depth of 400 meters at a speed of eight meters per second. The machine is of the Koepe type.—Lond. *Elec. Rev.*, April 14.

Cleaning of Blast Furnace Gas.—SAHLIN.—A paper read before the Iron and Steel Institute and giving a review of the various methods of dry cleaning and wet cleaning of blast furnace gases for use in gas engines.—*Eng'ing Record*, May 27.

TRACTION.

France.—DU BOIS.—His report to the International Railway Congress on electric traction in France, containing a great many statistical data.—*St. R'y Jour.*, May 20.

Birmingham.—The first part of an illustrated description of a 12-mile line of the Birmingham & Midland tramways, which has recently been electrified.—Lond. *Elec. Rev.*, April 28.

Worm Gearing for Tramway Cars.—HERZOG.—An illustrated description of a street railway car in which the motors are connected with the diving axle by means of worm gearing. The construction is described in detail and various advantages of the construction are pointed out.—*Elek. Bahnen*, April 14.

Block Signals.—An illustrated description of the automatic block signal system of Oestereicher, which is being introduced on Austrian railways.—*Elek. Anz.*, March 23.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

German Central Station Statistics.—HOPPE.—Some statistical notes on the development of German central stations. From April, 1903, to April, 1904, is shown in Table I.

Systems.	No. of Stations 1903.	No. of Stations 1904.	Increase or decrease.	Capacity in kw 1903.	Capacity in kw 1904.
Direct-current with storage batteries	738	803	+65	251,073	245,220
Direct-current without storage batteries	28	40	+12	6,170	2,346
Single-phase and two-phase systems	45	41	— 4	30,550	37,717
Three-phase system	59	63	+ 4	83,283	70,586
Monocyclic system	2	2	0	970	1,182
Combined direct-current and three-phase system	55	64	+ 9	102,470	164,499
Combined direct-current and single-phase system	12	15	+ 3	8,041	9,397
Total	939	1028	+89	482,557	530,947

The author calls attention to the fact that single-phase and polyphase systems are used to a far less extent than the direct-current. In 49 stations which were built during the year gas engines are used as prime-movers, gas power being used exclusively in 33 works. The number of stations in which steam power is used has increased by 40 during the same year. The ratio of central station capacity to lighting connections was 1.56 in April, 1904, and 1.65 in 1903. The ratio of a central station capacity to motor connections was 2.23 in 1904 and 2.45 in 1903. The ratio of central station capacity to total connections was 0.92 in 1904 and 0.97 in 1903. From data of a selected number of works, it is estimated that the average capital invested per kilowatt of central station capacity is $325, and the investment per 1,000 inhabitants is $11,000. The total capital invested in German central stations is estimated as $172,500,000.—*Elek. Anz.*, March 30.

Traction Lighting and Heating Plant.—ROBINSON.—An article on the system of the Public Service Corporation of Bloomington, Ill. The traction system comprises approximately 16 miles of tract between Bloomington and Normal, Ill. The lighting system is of the alternating-current type throughout. In Bloomington current is supplied to some 300 multiple arcs and 10,000 incandescent lamps, while in Normal a 70-light, series alternating-current system is used to furnish arc lights for both the streets and the State Normal School.

In connection with its power station the company supplies heat to business houses, flats and private residences in form of hot water at 18 cents to 20 cents per cubic foot, the total radiating surface being 83,000 sq. ft.; the Varyan system of transmitting water which has been heated by exhaust steam is employed. The same water is used over and over again, the leakage being supplied by a small automatic pump. The equipment includes eight heaters (one of 5,000 sq. ft. of radiating surface) and two duplex pumps for forcing the hot water through the pipes at 60 pounds pressure, returning at 30 pounds. The power station contains two 550-volt railway generators of 300 and 400 kw, respectively, while for lighting and power purposes two 2,200-volt, two-phase alternators of 300 and 400 kw, respectively, have been installed.—*St. R'y Jour.*, May 27.

Large Units.—Several communications pleading for the use of fewer and larger units in central stations. Rider gives the reasons in their favor very forcibly and thinks that the proper size of unit for any power station must depend upon (1) the use to which the station is to be put, and (2) the ultimate size it is intended that the station shall reach. In his opinion the size of unit should be selected which will give six, or at the most eight, machines in the completed power house; not in the first section, or in the first section plus the first or second extension, but in the largest power house which it is advisable to build on the site. The proportion of spare plant to running plant may appear large when the first installment is erected, but that period will soon pass, never to return. Gamlen speaks in favor of larger units mainly for the reason of the great diminution of capital expenditure.—Lond. *Elec.*, May 5.

WIRES, WIRING AND CONDUITS.

Insulating Varnishes.—TURNER.—Insulating varnishes were originally constructed so as to insulate a copper conductor to exclude moisture and to stand a high temperature for a lengthy period without deterioration. More recently the requirement of good heat conduction and radiation has been added. In a communication on this subject Turner says that he developed in 1900 and 1901 a compound which is now known as "electro-enamel" and which has been found to greatly decrease the temperature rise of coils on which it is employed. It also preserves the cotton covering from deterioration at very high temperatures. He thinks that a method of treating coils with such a compound should supersede the "absurd and now antiquated" method of employing asbestos coverings for the conductors of the field spool of railway motors. It is true that coils wound with asbestos-covered wire have a low temperature rise as determined by a thermometer placed against the surface, but the temperature rise as determined by resistance measurements will be far greater, and will exceed the temperature rise of the impregnated coil without any asbestos coverings on the wire. Moreover, the asbestos-covered wire has a much larger diameter for a given diameter of copper wire, and hence involves a greater mean length of turn than cotton-covered wire, requiring a greater weight of copper and more space for the

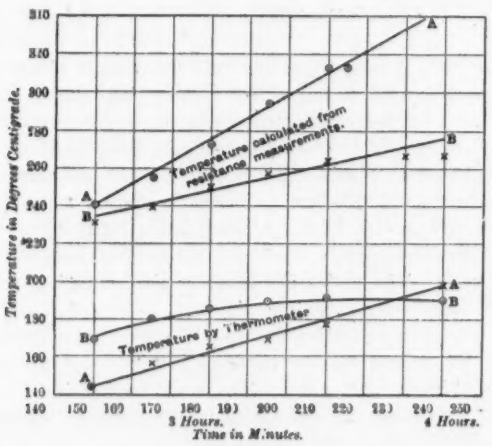


FIG. 2.—TEMPERATURE CURVES.

coil, and involving a lower efficiency due to the higher resistance per turn. The curves in Fig. 2 relate to results obtained on two field spools of a 35-hp railway motor. Spool A was wound with No. 6 S. W. G. wire insulated with two coverings of asbestos and two of cotton over the asbestos. Spool B was wound with No. 6 S. W. G. D. C. C. wire, which was drawn through a bath of electro-enamel during the winding process. The two spools were connected in series, and a current of 53 amp. was sent through them for four hours. At the end of this heat test the outer insulation on the coils was removed, and it was found that the asbestos plus cotton was charred so that it could be brushed off with the fingers, while the impregnated cotton-covered wire coil was intact, being both electrically and mechanically as sound as before applying the test. When the outer insulation on the asbestos-covered wire coils has been mechanically abraided the moisture gets in and is absorbed by the asbestos, which in time short-circuits the turns or causes grounds to the frame. Field spools with impregnated cotton-covered wires are lighter and cheaper than asbestos-covered coils.—Lond. *Elec.*, May 5.

Conductivity of Copper.—A paper on the effect of impurities on the electric conductivity of copper. Electrolytic refining has made it possible to produce copper of a very high degree of purity. The metallic impurities average but a few thousandths of one per cent; oxygen is usually present in the form of cuprous oxide, bringing the total impurities up to about a tenth of one per cent. The author has carried out extensive tests of a series of impure coppers by adding a very small amount of various elements which would lower the conductivity three or four per cent. The results are given in tables and diagrams. They show what a severe requirement the customary 97 or 98 per cent conductivity specification is, especially as copper is usually associated with arsenic; and when it is considered that the average electrolytic refinery daily passes this requirement by a margin of two or three per cent, frequently using anodes containing one more per cent of arsenic, it will be appreciated that electrolysis would have come as a refining operation even if copper did never carry gold or silver.—*Bi-Monthly Bulletin of Am. Inst. Min. Engrs.*, May.

ELECTROPHYSICS AND MAGNETISM.

Magnetic Wave Detectors.—WALTER.—Some notes on the effect of electric oscillations on magnetism. The author draws attention to the fact that there does not exist any generally accepted explanation of the action of magnetic detectors, and that there is much confusion with respect to several terms used in connection with this subject. For instance, a distinction should be made between Marconi's original cyclic flux detector and the practical moving band form, which might be called the Rutherford form. Further, the word hysteresis is used with two meanings, which should be carefully kept separate; first, the lagging of magnetization behind the induction; and second, the energy loss due to such hysteresis. This distinction is important since very high frequency oscillations, in general, reduce the hysteresis lag and at the same time increase the hysteresis loss (with increasing or rotating field, and in the most sensitive region). In the case of the cyclic flux detector, when the magnetism (field) is decreasing, the arrival of oscillations produces actually an effect of the Rutherford demagnetizing nature; when the magnetism (field) is increasing, on the other hand, although the hysteresis proper (lag) is diminished, the actual cause is the increase of flux due to the oscillations; these latter, in fact, facilitate the magnetization, as they before assisted the demagnetization; and in general the result is an increase of hysteresis loss due to the increase of such loss with the induction. (A decrease of hysteresis loss takes place in stronger fields, but the effect is very small.)—Lond. *Elec.*, May 5.

Thorium.—SLATER.—An investigation in which was studied the effect on thorium-excited activity of the cathode ray discharge, and of heat. The two stages in the disintegration of thorium-excited activity, whose existence has been already indicated by theoretical considerations, are always present simultaneously on a surface which has been exposed to thorium emanation. The constituent with the slower rate of decay (half value in 11 hours) is the one first formed, and may be called thorium A. The thorium B formed from it, which is responsible for the radiation emitted, is the substance whose rate of decay is the more rapid one (half in 55 minutes). These two substances show differences in their properties by means of which they may be separated. They are both partly volatilized on exposure to the cathode ray discharge, thorium B being more volatile than thorium A under these circumstances. The cause of the volatilization is an electrical one, being partly a direct action of the cathode rays, and partly a sputtering of the active matter, somewhat similar to that observed with metallic cathodes. Under the influence

of heat, thorium A is more volatile than thorium B. The former constituent can be almost entirely removed by keeping an active wire for a few minutes at a dull red heat. There is then left on the wire nearly pure thorium B, the activity of which decays to half value in about 55 minutes.—*Phil. Mag.*, May.

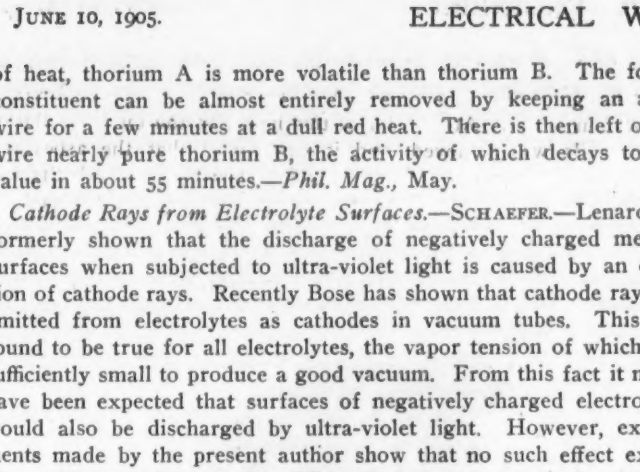
Cathode Rays from Electrolyte Surfaces.—SCHAEFER.—Lenard had formerly shown that the discharge of negatively charged metallic surfaces when subjected to ultra-violet light is caused by an emission of cathode rays. Recently Bose has shown that cathode rays are emitted from electrolytes as cathodes in vacuum tubes. This was found to be true for all electrolytes, the vapor tension of which was sufficiently small to produce a good vacuum. From this fact it might have been expected that surfaces of negatively charged electrolytes would also be discharged by ultra-violet light. However, experiments made by the present author show that no such effect exists. The author emphasizes the difference between negatively charged metallic surfaces—in which the charge consists of free negative electrons and negatively charged electrolytes—in which the charge is due to ions. An electron may be dissipated by ultra-violet light, but not an ion.—*Phys. Zeit.*, May 1.

ELECTROCHEMISTRY AND BATTERIES.

Electrolytic Rectifier.—COOK.—An illustrated account of experiments bearing on the theory of the electrolytic rectifier. His main results are as follows: The high apparent resistance of the electrolytic rectifier, when aluminium is the anode, is due to the counter electromotive force produced by the difference in charge of the cations around the carbon plate and that of the anions around the aluminium plate. So long as the potential is below the critical value the resistance of the film to the transfer of electricity is such that very few of the anions pass through it. When the aluminium is the cathode hydrogen forms between the metallic aluminium and the film; this action breaks the film and exposes metallic aluminium, thus allowing only a small polarization and hence a low resistance. There exist two potentials, depending on the temperature, at which the film of aluminium undergoes a change such that its resistance to the passage of the ions is decreased, the first being at a potential whose value is about one-third the value of the second. The second is at the critical value of the potential and is due to the crystallization of the film.—*Phys. Rev.*, May.

Oscillating Direct-Current Motor Meter.—An illustrated description of an oscillating motor meter for direct current, made by the Allgem. Elek. Ges. for 3 to 3,000 amperes at 60 to 600 volts. The meter is admitted by the Reichsanstalt, which issues an official description and rules on its calibration. The meter consists of two separate parts. The first part is an electrodynamometer with stationary main coil and movable shunt coil. The movement of the shunt coil is damped by a magnetic brake and is limited in both directions by two pins which act as contacts. These contacts actuate the second part of the meter, which consists of a reversing device, the current being reversed in the movable coil as soon as it touches one of the pins limiting its movement. At the same time a counting device which is connected with the reversing device progresses by one tooth for every second reversal of movement. Of the various systems developed, two are shown diagrammatically in Figs. 3 and 4, both referring to three-wire systems. The main current flows through the field coils F, the shunt current from $Z+$ through the resistance W, the coil U_2 of the reversing device, two resistances $W_2 W_1$, the second coil U_1 of the reversing device, the coil H to $Z-$. From the wire which connects the resistances W_1 and W_2 connection is made to one end of the movable coil D, while the other end of this coil is connected with both the contact C_3 and the reversing device C_6. While C_3 makes contact with C_1 and C_2 for a short moment only, the armature C_6 always rests on one of the contacts C_4 or C_5, whether the coils U_1 and U_2 carry current or not. If, for instance, C_6 makes contact with C_5, the moving coil is in shunt with W_2 and one-half of U_2. Since the moving coil has a far smaller resistance than W_1 or W_2, about nine-tenths of the current passes through the moving coil and only about one-tenth through W_2 and one-half of U_2, so that the latter are nearly without current. In this way the action of the coil U_1 preponderates and attracts the armature C_6 firmly against the contact C_5. Under the action of the flux of the main current the moving coil now moves slowly toward C_1. As soon as the contact is closed, the current has a non-resistive way from C_1 to the middle of U_2. As a result, the moving coil and U_1 are without current and the armature C_6 turns over to C_4. In the moment when C_6 leaves C_5 the current begins to flow from C_1 through D and W_2. The current now passes in reversed direction through the moving coil so that the latter now tends to move from C_1 to C_2. If the pin C_3 should leave the contact C_1 before the armature C_6 reaches the contact C_4, the circuit of the moving coil would be interrupted and a spark would appear at C_1. In order to avoid this, C_4 and C_5 are placed very near together, and small springs are provided on the same so that when the armature C_6 leaves the spring on one side it makes contact almost immediately with the spring on the other side. The torque of the moving coil is proportional to the product of main current and shunt current. Therefore, as long as the friction resistances which counteract the motion are small the movement of the coil or the number of the reversals of this movement (which are registered by the counting device) measure the power in the circuit. The influence of friction at low load is compensated for by means of the auxiliary coil H. The construction is described in great detail and a great many illustrations are given.—*Elek. Zeit.*, May 18.

Revolving Motor Meter for Direct Current.—An official statement of the Reichsanstalt that it has admitted for calibration the revolving motor meter for direct current made by the Allgem. Elek. Ges. for currents of 3 to 100 amperes at 60 to 600 volts, together with a detailed description of its operation. The connections for a three-wire system are diagrammatically shown in Fig. 5. The armature D contains only one coil, the ends of which are connected with the double collector C. D, with one or two resistances W and the auxiliary coil H, forms a shunt circuit connected to the outers in a three-wire system and fed with a current proportional to the e. m. f. of supply.



FIGS. 3 AND 4.—OSCILLATING MOTOR METER.

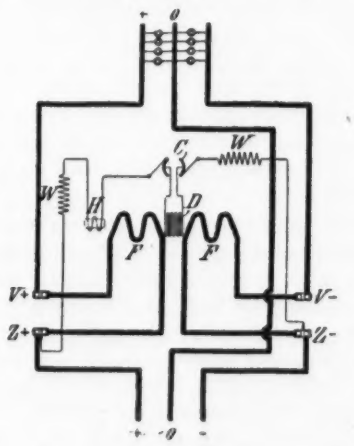


FIG. 5.—REVOLVING MOTOR METER.

The armature D revolves in the flux due to the two main coils $F F$; twice during every revolution (when the axle of coil D comes into the direction of the flux) the torque goes to zero. For this reason a small piece of iron is mounted on the axle of D; it is attracted by the brake magnet and tends to bring the coil D out of the zero torque position. From the brake disk in which the work performed by the motor is consumed two sectors, opposite each other and each about one-sixth of the area of the disk, are cut out so that in the moments when the torque gets small and passes through zero no braking effect is produced. To increase the flux the main current coils are

surrounded by dish-formed iron discs. The remanent magnetism in the iron has the effect that a small torque acts on the armature even when no current flows in the main coils. This torque just compensates for the friction; to insure that the torque does not get greater there is provided an adjustable auxiliary coil which produces a weak field opposite to that of the main coils. The construction of the meter is described in detail and illustrated.—*Elek. Zeit.*, May 18.

Electricity Meters.—GERHARDI.—A continuation of his illustrated serial describing electricity meters. In the present installment the Eclipse meters working on either continuous or alternating current circuit, the Schuckert meter and the Duncan meter are described.—*Lond. Elec.*, May 19.

Eddy-Current Brake.—MORRIS AND LISTER.—The conclusion of their paper on eddy-current brakes for testing motors. The authors give the theory of their brake.—*Lond. Elec.*, May 12. An account of the discussion which followed the paper is given in *Lond. Elec.*, May 19.

MISCELLANEOUS.

India Rubber Gloves for Firemen.—A note stating that owing to the increase in the use of electric power india rubber gloves are provided for London firemen on all occasions, as they often have to deal with electrically charged wires. An insulating material less affected by heat than is india rubber would be preferable, if such a one could be found.—*Lond. Elec.*, May 19.

New Underground Cable System.

BY AXEL HULTMAN.

THE rapid extension of the telephone early necessitated placing subscribers' lines underground, and to-day there is no large modern telephone system without underground cables running out of the central office. In Europe it is held, however, that not only town lines need to be laid in this manner, but also long-distance lines, which become numerous in the neighborhood of important centers, for it becomes impracticable to build the ever-increasing toll lines along railway and country roads, especially as these routes are often occupied by power circuits.

The number of long lines in the neighborhood of Stockholm having become inconveniently large, the Swedish Telegraph Administration began experimenting in 1892 with a cheap method of running lines, and has continued the experiments ever since.

The problem presented in underground work is two-fold: (1) To make the conduit cheap and yet air-tight throughout, and at the same time to afford a complete mechanical protection to the conductors. (2) So to place the conductors in the conduit as to prevent induction and maintain permanently their relative positions.

While experiments have been made with lead-covered paper cables containing heavy copper wires, spaced as far apart as possible, it is doubtful if the general problem can be solved in this manner at a reasonable cost, for a wide spacing between wires cannot be obtained without an increase of outside diameter and a corresponding increase of cost; then again such heavy lead cables are difficult to transport and to lay.

In the system to which this relates the conductors can be spaced as far apart as permitted by the limits of cost and room available in each case, and without a considerable increase in the cost of materials the capacity may be brought down 5 or 10 per cent. under the lowest figures given below. The cables laid hitherto have the conductors of each pair 17 mm. (.75 in.) apart, while the distance between pairs is 28 mm. (1.12 in.) and no conductor is less than 5 mm. (.2 in.) from the conduit; this corresponds for 2 mm. conductors to 0.00985 microfarad per kilometer for the inner conductors, and to 0.0132 microfarad per kilometer for the outer conductors, nearest the conduit. By increasing these distances to 20, 36, 36.5 and 10 mm., respectively, the capacity is reduced to 0.00935 and 0.0125 microfarad per kilometer, respectively. It is manifest that with such low capacity and with the addition of loading coils, underground circuits can be operated over long distances.

The first experiments with the system on a large scale were made in 1899. Owing, however, to various circumstances, the first line was not satisfactory. The next experiment on a large scale was made in the spring of 1902 during very bad weather, when the insulation came out at 20 megohms per kilometer, which remained the same in the spring of 1903, thus proving that the protection of the conduit could be relied upon. This line was laid rapidly under unfavorable circumstances, and so near the surface of the ground as to be exposed to the full effect of frost; it was laid partly on hilly and partly on marshy ground. The conduit is an iron pipe laid in cement.

The next conduit line was built in the summer of 1903, but the conductors were drawn in only in 1904, and gave 264, 158 and 80 megohms per kilometer. Four wires were bad owing to a fault. Fig. 2 shows the work of laying this line. During the present winter the conduit laid in 1902 was taken up and carefully examined, the

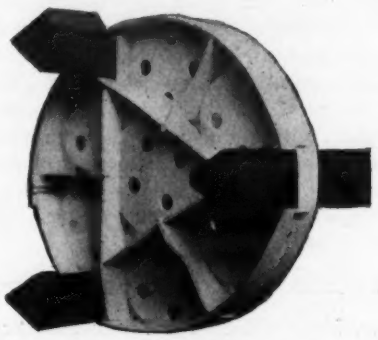


FIG. 1.—DISC.

result showing that it had remained throughout in the same condition as when laid.

In order to maintain the wires in place a variety of discs have been tested; one of these is shown in Fig. 1. This disc has been changed and improved, and with the latest devices no contacts either between conductors or between conductors and conduits can take place after the cable has been drawn in and fixed in place.

The mode of construction now used, however, renders these cables more expensive than was expected, but not beyond measure, specially when the low capacity is considered. A 28-wire conduit and cable can be laid down complete for $1.30 per yard. allowing a reasonable profit. In this price the conductors themselves are not included, for they may vary from 1 to 4 mm. A 76-wire route may be built for about $2 per yard and a 148-wire route for $3 per yard. Labor is the principal item of expense, but this is now brought down

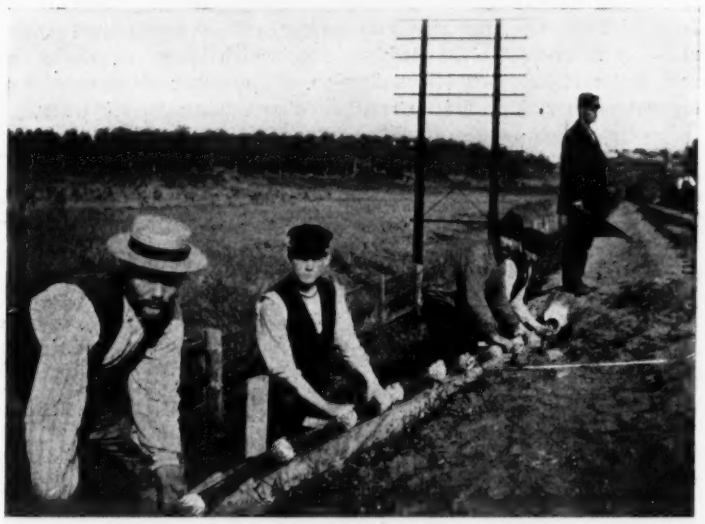


FIG. 2.—LAYING CABLES UNDERGROUND.

to a minimum by having most of the work done in the factory. On the ground the work is confined to the trenching, the laying and jointing of the conduit and the drawing in of the cable, operations which are simple and done rapidly by trained men.

The conduits are laid along railways close to the surface of the ground, being covered only enough not to interfere with railway work. Into this conduit the cable is drawn, being brought from the factory ready provided with insulating discs. The drawing in is easy and takes only a few minutes for each section of 1,000 ft. The stringing of the wires through the insulating discs is done partly on a machine and partly by hand. They are arranged in fours in such a

manner as to avoid induction between conductors. This requires certain operations to be performed by hand, but these are reduced to a minimum. This hand labor, however, pays, as it permits twice the number of conductors to be gotten into the same space as would be occupied by paired wires.

A New Four-Valve Engine.

A new type of four-valve engine in the design of which especial attention has been given to the matter of steam economy is shown in the accompanying illustration. Chief among the very radical improvements that have been made is the placing of the admission and exhaust valves directly in the cylinder heads rather than at the top and bottom of the cylinder, as has heretofore been the custom. This construction results in a reduction of practically 4 per cent in the clearance, and it is evident that the saving in steam effected in this way is quite material. It is worthy of note that live steam is kept constantly in contact with the entire top of the cylinder and the

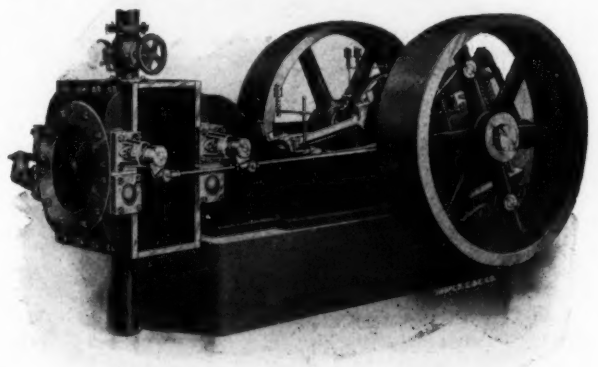


FIG. 1.—FOUR-VALVE ENGINE.

upper portion of both heads, so that the loss of steam from condensation is greatly reduced. The steam valves are operated directly from a movable eccentric forming a part of the automatic shaft governor, and are entirely independent of the exhaust valves. The latter are operated from a fixed eccentric on the main shaft, in this way insuring uniformity of compression under all conditions of load and pressure. The connections are all of the "straight line" type, and they involve no multiplicity of parts.

Both the steam and the exhaust valves are double-ported, and it is claimed that practically no "wire drawing" of steam exists in this type of engine. (See Fig. 2.) Various tests made in the Atlas shops, as well as in the field, indicate a steam consumption practically identical with that of the Corliss type of engine, and a regulation

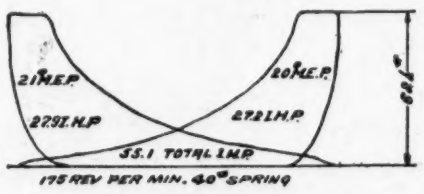


FIG. 2.—INDICATOR DIAGRAM.

of from 1 to 1½ per cent under changes of load from friction to the full rated capacity.

In addition to the line of medium-speed engines, the builders, the Atlas Engine Works, Indianapolis, are also offering a high-speed center-crank engine for electric service. This type has the reciprocating parts enclosed under an oil-tight hood. At each revolution of the shaft the crank, crank-pin, crosshead-pin, crosshead guides and main bearings are showered with oil from a reservoir in the crank-pit, into which the connecting rod dips. Oil from the same source is also delivered by centrifugal force to all other reciprocating parts and is finally returned to the reservoir in the crank-pit. This system of lubrication has proven to be very effective, and coupled with the other advantageous features of the engine, should serve to make the latter very popular for direct connection to electrical generators.

Fort Wayne Prepayment Wattmeters.

The Fort Wayne Electric Works is placing upon the market a prepayment wattmeter which is claimed to require such an extremely low torque for the operation of its prepayment mechanism that the smallest amount of energy which will cause the meter to run will operate the device perfectly. The new prepayment mechanism, which is very compact in form and neat in appearance, has been applied to the well-known Fort Wayne Type K induction integrating wattmeter, as well as to the new "Wood" Type W meter recently described in these columns. Fig. 1 is an outside view of the Type K prepayment wattmeter, while Fig. 2 shows the same mechanism applied to the Type W meter.

These meters are at present designed to operate with a dime and may be credited with two dollars' worth of energy at one time. The capacity of the money box is $10. A meter will, however, soon be

FIG. 1.—PREPAYMENT WATTMETER.

placed on the market whose operating coin will be the quarter, since considerable demand has already been made for such a meter. This meter may be credited with $5 worth of energy at one time and has a total capacity of $12 in quarters. The amount of energy which can be obtained for the money deposited may be varied whenever desired, although the adjustments for the rate cannot be made until the meter has been properly unlocked.

Upon inserting a coin into the slot at the top of the meter the former acts as a key, locking the crediting device to the knob so that one-half turn of the latter credits the coin upon the dial and deposits same in the money box. This operation is accomplished as follows:

Upon the farther end of the crediting spindle is a pinion which engages an intermediate gear. This intermediate gear also engages the inside annular gear of the escapement mechanism. The coin acting as a key in rotating the above pinion, causes the intermediate gear to roll about the pinion as an axis. This forces the numbered dial ahead under the tension of a flat coiled spring. Thus power for the debiting operation is stored up in the spring. This operation of crediting may be repeated until the dial at the top of the meter shows twenty dimes credited.

After the coin has once been inserted and the knob turned, it is locked within the meter and can only be obtained by opening the

money box. It is only by turning the knob one-half revolution that the consumer can obtain credit for his payment. After twenty dimes have been credited the slot is closed, preventing the insertion of another coin until a dime's worth of energy has been used.

The same operation that credits the first coin in the meter causes the circuit to be closed by means of a cam on the crediting drum. This cam operates a lever arm which in turn engages the switch bar and closes both circuits under the tension of a coiled spring. Fig. 3 shows the details of this switch.

After the amount of energy purchased has been used, and the drum, in debiting the coins, has returned to its initial position, the same cam releases the spring and causes the switch to open.

The only connection between the prepayment device and the recording train of the wattmeter is a pinion upon the former which engages a gear in the latter.

In the operation of debiting every revolution of this pinion causes a stop to be removed from the gear train in the prepayment device by means of a cam mounted upon the pinion shaft. The gear train thus released is free to revolve. This train consists of three gears and three pinions; one of the latter, however, simply operates a retarding fan. (See Fig. 4.)

In debiting, the intermediate gear in rolling about the center stud under tension of the coiled spring carries with it the internal annular gear and causes the whole escapement motion of the prepayment

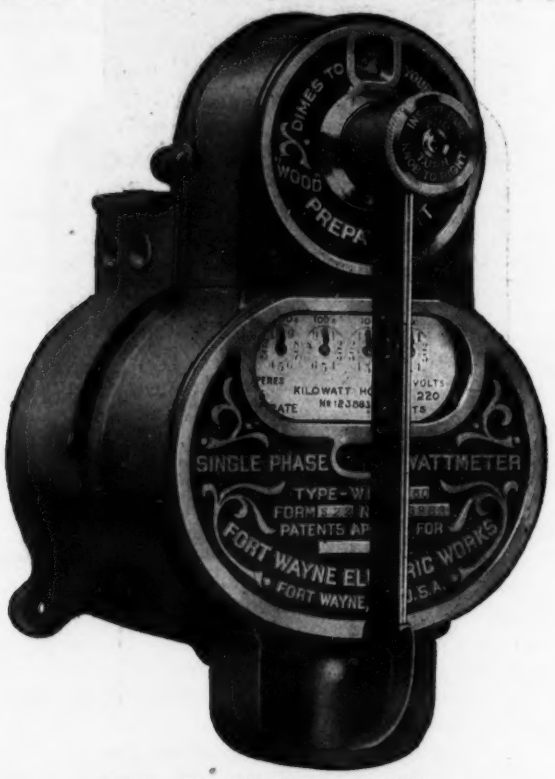


FIG. 2.—PREPAYMENT WATTMETER.

device to operate, providing the latter be unlocked by one rotation of the small pinion as explained above.

The ratio of gears in the escapement train is fixed at such a value that when the dial has moved sufficiently to allow the next lower number to appear thereon, a pin upon the periphery of one of the large gears acts as a cam forcing a stop lever into such a position that the latter immediately engages a pin on one of the lower gears and stops the whole mechanism. Thus it will be seen that for every revolution of the small pinion which engages the wattmeter recording train, one number is subtracted on the dial and the switch cam is brought just so much nearer to the position in which it operates the switch and opens the circuit.

One of the valuable features of this prepayment meter is its ability both to credit money and debit energy at the same time. It is possible to accomplish this operation for the reason that the only connection between the crediting stud and the debiting escapement motion is an intermediate gear whose axis is not fixed.

In crediting, the intermediate gear rolls about the central pinion; in debiting, the annular gear, together with the intermediate gear, rolls about the central pinion. Thus, when both operations take place at one time, the pinion and the annular gear turn in opposite directions at equal speeds, causing the intermediate gear to simply revolve upon its own axis without changing the numbers on the dial in any way. Although the debiting device is usually locked during the crediting operation, it will be seen that the value of the meter is greatly increased by its ability to perform both operations simultaneously when such an occasion arises.

The money box of this meter has been designed with the idea of making it as nearly tamper-proof as possible, for it is not possible

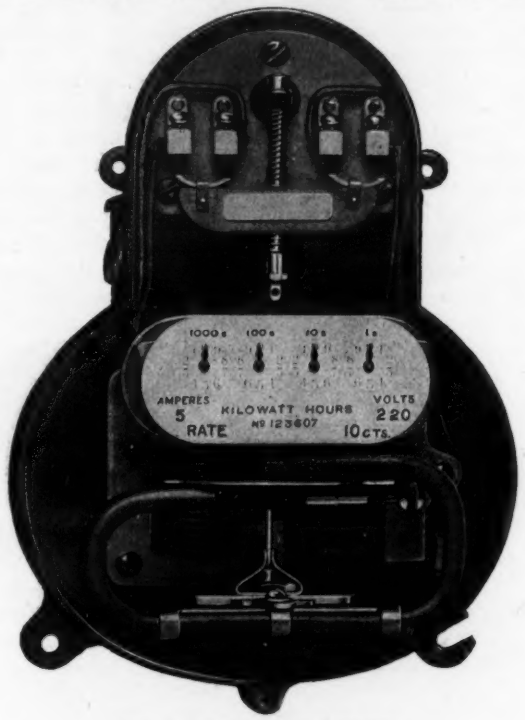


FIG. 3.—DETAILS OF SWITCH.

to gain access to the lock without first breaking an auxiliary seal. When the lock is reached it is found to be of the concealed Yale type, which cannot be picked, and can be opened only by one special key in the possession of employes. This operation of removing the box, however, can be accomplished without interfering with the meter in any way.

The flexibility of this meter will at once attract the interest of the

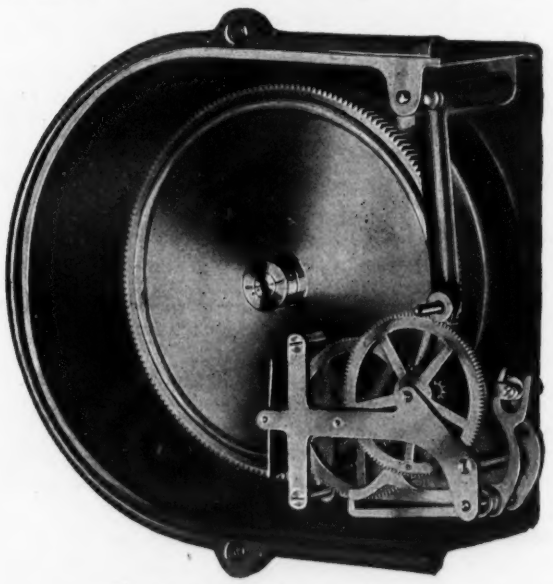


FIG. 4.—GEAR TRAIN.

central station manager. It can be readily adjusted for any rate up to 20 cents per kw-hour, and its principle of combining the time switch with the integrating wattmeter will gain for itself an entirely new field of service, especially in sign lighting. With this meter the central station will be protected and the consumer will feel better satisfied. It is the ideal installation for the consumer using small amounts of power, and in addition it will reduce the amount of bookkeeping and fault-finding to a minimum.

The Deutsch Electric Train-Lighting System.

The problem of obtaining a constant electromotive force from a generator driven at a variable speed is the most difficult encountered in the design of a successful train-lighting system. In the Deutsch axle-lighting system the problem has been solved by employing a

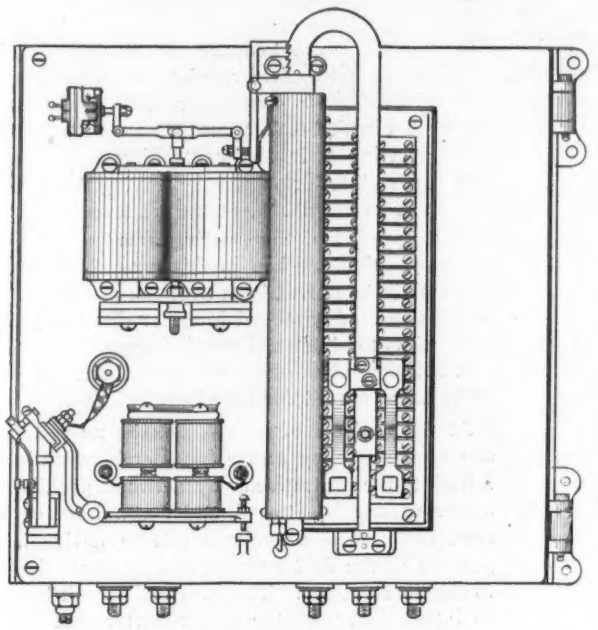


FIG. 1.—FIELD RHEOSTAT AND ELECTROPNEUMATIC VALVES.

pneumatically-operated rheostat for varying the resistance of the shunt field circuit of the generator.

For the purpose of maintaining the e.m.f. when the generator speed is below the minimum value for self-excitation, and for supplying current to the lamps when the train is at rest, the usual storage battery is suspended in a box under the car body. An electromagnet is arranged so as to admit compressed air from the brake system into a cylinder whose piston operates the rheostat in the field circuit

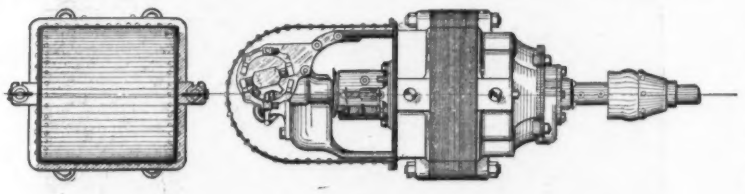


FIG. 2.—GENERATOR.

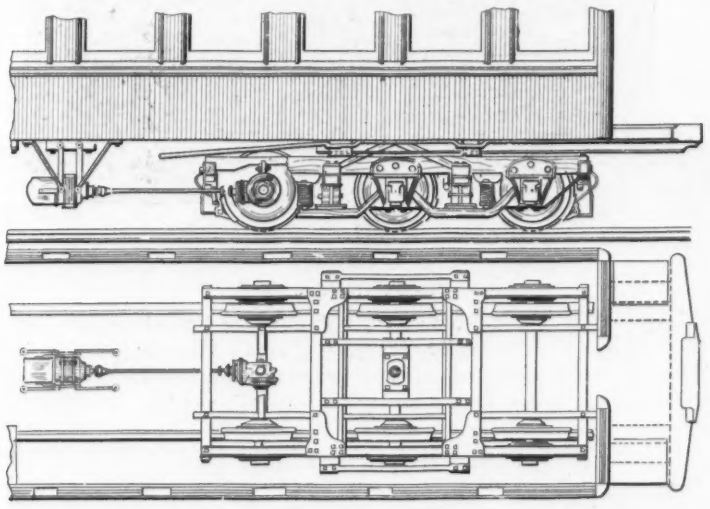


FIG. 3.—VIEW SHOWING TRANSMISSION GEARING.

whenever the speed of the generator is such as to cause it to produce an e.m.f. greater than the normal value of the system. The result of the movement of the piston is to decrease the e.m.f., so that whenever the speed is above the critical minimum value the generator supplies current both to the lamps and to the storage battery in a limited quantity, while when the speed is too low the lamps receive current from the storage battery The compact and substantial nature of the construction of the rheostat, air valves and solenoids may be obtained from Fig. 1.

The sturdy construction of the generator may be seen from Fig. 2. The commutator end of the generator is protected by a sheet-iron case, which can be removed quickly by loosening two wing nuts. A special effort has been made to render the generator free from troubles, but ample provision has been made for remedying any trouble which may arise. The two end bearings are similar in all respects, and all screws which must be removed for affording access

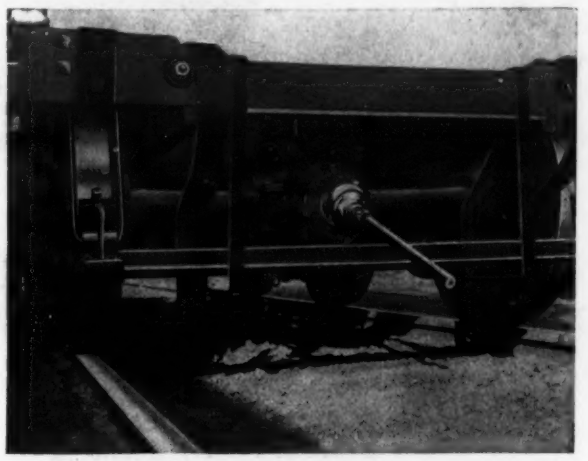


FIG. 4.—VIEW OF TRUCK SHOWING TELESCOPIC SHAFT.

to the armature are of a uniform standard size. It is stated that a new armature can be substituted for an old one in about fifteen minutes.

The method of suspending the generator is one which insures against the jar incident to direct connection. The generator is fastened rigidly to the car body, and is driven through a telescopic shaft by means of a bevel gear mounted on the axle of the car. (See Figs. 3, 4 and 5.) The telescopic shaft is provided with universal joints to allow for any motion of the axle with reference to the body of the car. The pinion which transmits motion from the steel bevel gear to the telescopic shaft is made of rawhide, so that the gearing operates practically without noise. Another feature which contributes to the noiseless operation resides in the silent performance of the compressed air valves and the rheostat. It is stated that this drive is not affected by snow, ice, sand, escaping steam or tipped truck, while its parts are simple, durable and of easy access. It has no sliding dust guards to work loose and make holes in the casing.

It is claimed that the service rendered by the Deutsch axle lighting system is so reliable that no reserve battery need be installed upon a car. The licensee of this system for the United States, Canada and Mexico is the Electric Controller & Supply Company, of Cleveland, Ohio.

FIG. 5.—CAR EQUIPPED WITH DEUTSCH SYSTEM.

Stanley Direct-Current Motors and Dynamos.

In response to a demand for a rugged and compact machine, readily adapted to special uses, such as direct application to various mechanical devices, there has been developed by the Stanley-General Incandescent Electric Manufacturing Company, Pittsfield, Mass., a line of semi-enclosed motors and dynamos, as indicated in the accompanying illustrations. The machines are provided with hinged covers which protect the commutator.

The field frames for these type "L" machines are of the bipolar

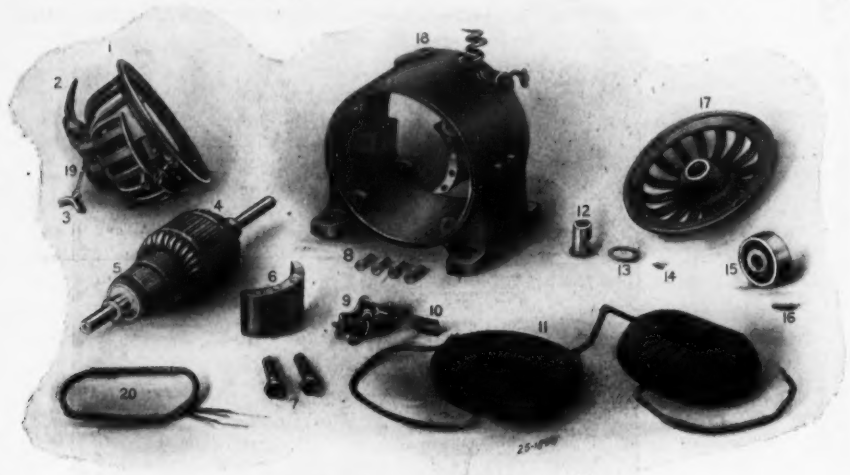


FIG. 1.—COMPONENT PARTS OF TYPE L MOTOR.

construction for capacities from .25 to 5 hp, and are of the multipolar form for sizes from 7.5 to 15 hp. The design of the laminated pole shoes, which are bolted to the pole pieces, is such as to assist in maintaining a proper distribution of field flux, and it is claimed

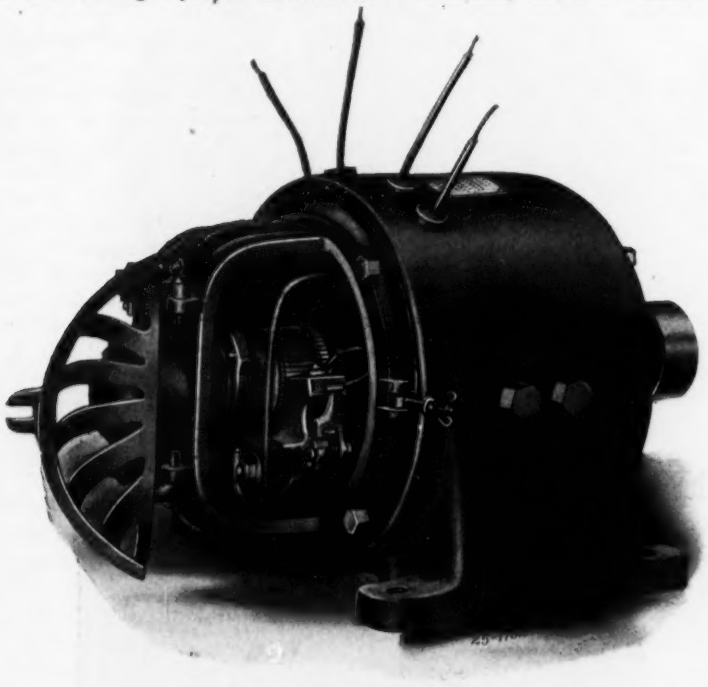


FIG. 2.—TYPE L MOTOR ASSEMBLED.

that the operation of these machines is sparkless under all conditions of load.

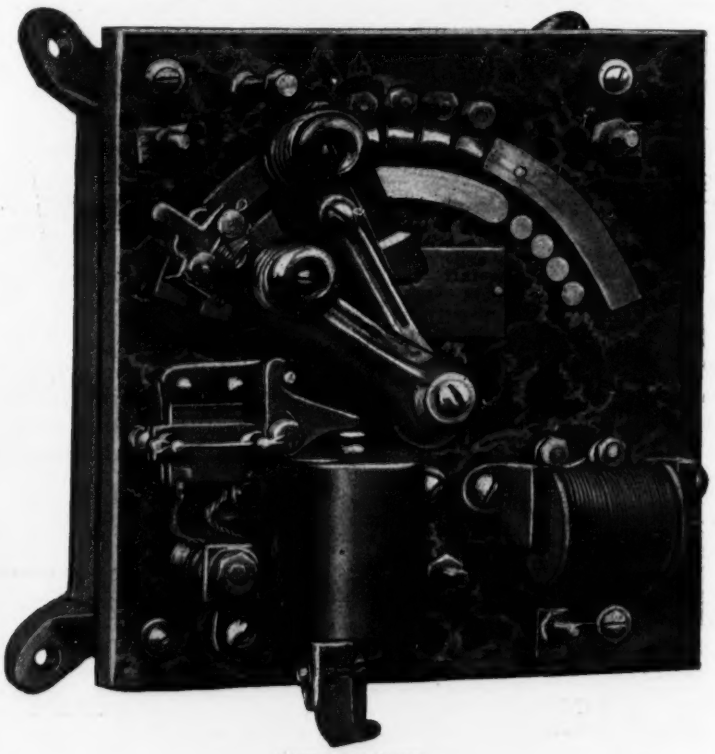
The journals are made of hard phosphor-bronze and are of the self-aligning type. The shaft is of crucible steel, ground to gauge, and polished at the bearings. It is found that, with the effective lubricating system by means of a continual circulation of oil, the friction at the bearings is reduced to the minimum value.

Owing to the liberal use of iron in the magnetic circuit and copper in the electric circuit, the good ventilation, the special laminated pole shoes and the generally excellent construction, the machines will withstand an overload of 50 per cent for one hour, or 100 per cent momentarily without injurious heating and without the necessity of adjusting the brushes. The efficiency is stated to be about 66 per cent in the smaller sizes, and to reach 95 per cent in the larger sizes. The insulation resistance of these machines exceeds one megohm, and its dielectric strength is such that it is capable of withstanding for one minute an alternating e.m.f. of 1,500 volts, effective value, between the frame and core of the machine.

Four Step Motor-Starter.

The cut herewith shows a Ward Leonard motor-starter equipped with four steps of speed control by field regulation. There are three arms pivoted on a common center, an interlocking overload circuit-breaker arm, a no-voltage release and a starting and speed-controlling arm. The two latter are so interlocked that by moving the no-voltage arm up to its magnet the motor is started and brought to full speed, and the starting arm is in its short-circuit position. When in this position the starting arm cannot be moved back over the starting contacts, but can be readily moved in either direction over the field points to obtain the speed changes desired. This arm is independent of the no-voltage retractile spring while being moved for speed control.

At the moment of no-voltage, the no-voltage arm strikes the starting arm a hammer blow and carries it back to the protective or open-circuit position. The motor cannot be started under condition of weakened field. The no-voltage release device is independent of the field strength and is responsive solely to the line voltage. The overload circuit-breaker is so interlocked with the motor-starter that it cannot be closed with the starting arm in any but the protective or open-circuit position, thus giving positive protection



MOTOR-STARTER.

against overload at all times, even during the period of starting. This starter and controller occupies a small mounting space, is absolutely fire and rust-proof, and proof also against short-circuits in the resistance due to the falling in of metallic chips.

Bids for Electric Light Plant.

Bids will be received until June 15 by the Mayor of Kearny, N. J., for material for a municipal electric lighting plant. Separate bids to be made on the following: Power house and foundation; chimney and breeching; boilers and steam fittings; engines; generators and exciters; switchboard, wiring, transformers, pole, line and fixtures, arc lamps. The cost of the plant is estimated at $55,000. Dunyon & Carey, 122 Market Street, Newark, are the engineers.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Improvement is noted in reports of trade and crop conditions, as a result of better weather. The northwestern cities return very optimistic reports, the central west is cheerful and some southern points report trade better than anticipated earlier. Effects on trade of the backward spring at the East are being repaired. Industry is still active, though the iron and steel trades are rather quieter, with crude materials easier, though scrap is in rather better tone. Building is generally active and, except at Chicago, labor troubles are not seriously hampering. All kinds of building material, including lumber, brick, cement, glass, paints, oils and hardware, are actively called for. Collections show little change, except in the direction of improvement in certain western centers. Money is still easy. Curtailment of pig iron production has already begun, but increasing supplies and inactive demand are indicated by easing of prices. Bessemer pig iron is 25 cents lower at Pittsburg and 50 cents lower at Cincinnati and at Birmingham, where $12.50 is the price for No. 2 foundry. Despite better demand in the foundry and pipe trades, pig adapted to these purposes is easing. Steel billets are 50 cents to $1 lower at most markets. Old iron and steel are also quoted lower. Off-grade coke is lower. Bituminous coal is still dull. Anthracite for domestic uses is active, but steam sizes are rather quiet at the 10-cent advance on May 1. The number of business failures during the week ending June 1, as reported by *Bradstreet's*, numbered 154, against 179 the previous week and 194 the corresponding week last year. The copper market was dull, and no sales of any consequence were made. Lake and electrolytic sold at 15 cents and casting stock is held at 14¾ cents, with but a small amount of business.

ALLIS-CHALMERS ORDERS.—The Allis-Chalmers Company reports several contracts for equipment, as follows: The Arizona Smelting Company, whose headquarters are in New York, has ordered shipped to its plant at Prescott, Ariz., the complete equipment for a sampling mill. The contract also calls for an electrically-operated converter and two reverberatory furnaces with auxiliary apparatus. The Sociedad de Minas y Fundiciones, Carrizal, Bajo, Chanarcitos, has ordered from Allis-Chalmers Company the equipment for a 50-ton copper smelting plant to be erected at Carrizal, Bajo, Chili, South America. The installation will include a blast furnace and blower, with auxiliary apparatus, and a Bullock type "B" generator to supply current for an electric light plant. Mr. William M. Martin, the manager of the Chilian company, was in Chicago recently for the purpose of purchasing this machinery. The Tacoma Smelting Company, Tacoma, Washington, has ordered a steel water-jacketed blast furnace for treating copper ores, the dimensions of which are to be 42 by 160 ft. at the tuyere line. It will be provided with a specially designed tuyere box. The Delaware & Hudson Coal Company, Scranton, Pa., has placed an order with Allis-Chalmers Company for four horizontal Reynolds Corliss girder frame engines. They will be used to operate two 28-ft. fans for mine ventilators, which are also to be furnished by Allis-Chalmers Company. The New Castle Portland Cement Company, New Castle, Pa., has placed an order for four rotary kilns, each 100 ft. in length and 7½ ft. in diameter at the large and 6½ ft. at the small end. The tendency of late in the cement business has been to lengthen the kilns. A few years ago kilns measuring 60 ft. were practically the standard, but kilns which are now being erected range from 80 to 125 ft. in length, 100 ft. being about the standard. In addition to the kilns Allis-Chalmers Company will furnish a crushing plant consisting of one No. 6 "K" Gates rock and ore breaker, two No. 4 Gates breakers, and one No. 6 elevator. The operation of these is as follows: The No. 6 breaker receives the limestone as it comes from the quarry and does the preliminary crushing. The discharged product is divided and sent to the two No. 4 breakers, which prepare it for the grinding. The Champion Copper Company, Chicago, Ill., has ordered from Allis-Chalmers Company a vertical cross-compound Reynolds Corliss condensing engine of 340 hp for direct connection to an alternating-current generator for its power house at Painesdale, Mich. The Florida East Coast Railway, with headquarters at St. Augustine, Fla., has ordered from the Allis-Chalmers Company two horizontal Reliance engines and a Bullock alternating-current generator, with exciter, for the operation of an electric light plant.

NEW ORLEANS RAILWAYS COMPANY.—Messrs. Sanderson & Porter, of New York, have purchased the following named apparatus for the new central power house, also for the new electric lighting and railway distribution system for the New Orleans Railways Company, New Orleans, La.: Two 12-in., 18-in., 10-in. by 16-in. boiler feed pumps, from Epping-Carpenter Company, Pittsburg, Pa.; gate valves for high-pressure superheated steam, and for other power purposes, from Chapman Valve Manufacturing Company, Indian Orchard, Mass.; steel, semi-steel and cast-iron fittings and high-pressure piping, from Pittsburg Valve, Foundry & Machine Company, Pittsburg, Pa.; six extra heavy flue economizers, aggregating about 2,160 pipes, from B. F. Sturtevant Co., Boston, Mass.; 50 tons of steel flues and dampers, from A. D. Granger Co., New York City; two 15-ft. diameter by 275-ft. high, self-supporting steel stacks, aggregate weight being about 200 tons each, from Hammond Iron Works, Warren, Pa.; switchboard equipment with electrically-operated, remote-control switches, and steam turbine and motor-driven exciters for power station; also a complete street lighting equipment of 3,000 7½-amp., alternating-current series arc lamps with regulators and switchboards for the same, and two 500-kw, motor-generator sets, from the General Electric Company. The boilers and superheaters were bought by Sanderson & Porter last year from the Babcock & Wilcox Co., of New York City, and the mechanical stokers from the Murphy Iron Works, of Detroit, Mich. The steel work is furnished and is being erected by the American Bridge Company, on heavy pile and reinforced concrete foundations, built by the New Orleans construction force of Sanderson & Porter, whose local office is also erecting the complete superstructure.

EQUIPMENT OF PLANTS.—The Brown Engineering Company, consulting and contracting engineers, of Reading, Pa., has been commissioned by the Textile Machine Works, of Wyomissing, Pa., to act as engineer in charge of the design and erection of their new power plant and system of electric drives. A new three-story concrete-steel building, 200 x 50, is being completed and will be used for textile work, principally braiding and knitting machines which will be equipped with individual motors and lighted by arc lamps equipped with concentric diffusers. There will be in all approximately thirty motor drives. This company has also been commissioned to act as engineer and has received the contract to equip the large plant of the Reading Stove Works, Reading, Pa., with electric power. A new power plant is being built and the various departments including foundry, tinsmith, cleaning and others will be operated electrically. The three-wire system, direct current, will be employed, derived from a single generator in which the neutral wire will be taken from a compensator. The Brown Engineering Company is under the management of Mr. Ellis E. Brown, Assoc. Memb. A. I. E. E., and formerly electrical engineer for the Philadelphia & Reading Railroad and Atlantic City Railway Company.

CANADIAN WESTINGHOUSE ORDERS.—The Windsor & Tecumseh Electric Railway is to be equipped with 300-kw, 3,300-volt Westinghouse single-phase engine type generators direct-coupled to Robb-Armstrong engines, and its car equipments are to consist of two 50-hp Westinghouse single-phase motors each. This is the first single-phase road in Canada. The generator voltage is fed directly to the car through the trolley wire, step-down transformers being carried by each car. The Chatham, Wallaceburg & Lake Erie Railway Company is building a new line of electric railway from Chatham to Wallaceburg, Ont., a distance of about 20 miles, through a rich farming and fruit-raising country. An order for four double equipments and one quadruple equipment of railway motors has been placed with the Canadian Westinghouse Company, Limited. To take care of its rapidly increasing business, the Hamilton Cataract Power, Light & Traction Company is making extensive additions to its power plant at De Cew Falls. Orders have been placed with the Canadian Westinghouse Company, Limited, for the following apparatus: Two 6,400-kw, three-phase, 2,400-volt, 60-cycle, 287-r.p.m. generators with motor-driven exciters and switchboard apparatus; four 3,200-kw, oil-insulated, water-cooled raising transformers.

LIGHT FOR WASHINGTON FILTRATION PLANT.—Contracts for furnishing and installing an electric light plant at the filtration plant have been awarded as follows: Engines, generators, switchboards, etc., Thomas W. Power, of Washington, for $6,069; material and labor to complete duct system, to the Brennan Construction Company, Washington, for $7,544; wiring, etc., including all material and labor not included in the other classes, to the National Electric Supply Company, Washington, for $32,299.

COPPER PRODUCTION LAST YEAR.—According to a dispatch from Washington the value of copper produced in the United States in 1904 was $105,629,845.

THE TWIN CITY RAPID TRANSIT COMPANY will install in its power house at the lower dam, St. Anthony's Falls, Minn., a vertical cross-compound Reynolds-Corliss condensing engine, for direct connection to a 3,500-kw, three-phase, alternating-current generator. This company had previously installed three Allis-Chalmers engines of the same size and type as the one now ordered, each having a normal capacity of 5,000 hp. The four engines are, however, capable of developing an aggregate of 36,000 hp.

TELEPHONE EQUIPMENT.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., reports having closed contracts for switchboards for the following places: McLain, Kan.; Oregon, Ill.; High Point, N. C.; Kampsville, Ill.; Cowden, Ill.; Plainville, N. Y.; Stanley, N. Y.; Mexico City, Mexico; Seattle, Wash.; Adrian, Mich.; Furley, Kan.; Elbing, Kan.

BIDS FOR SCHOOL EQUIPMENT.—Bids will be received until June 12 by C. B. J. Snyder, Superintendent of School Buildings, New York City, for wiring, installing electric lighting fixtures, etc., in School No. 18; also for installing electric bell, gong, speaking tube and telephone systems in Schools Nos. 9, 55, 72 and 74, all in the Borough of Brooklyn.

ELLIS ISLAND BIDS.—Bids will be received until June 17 for furnishing at the Immigration Station, Ellis Island, New York harbor, electrical supplies for the year ending June 30, 1906. Address Robt. Watchorn.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market showed some improvement under the expectation of peace in the East, but became unsettled later on when the probability of peace became modified by subsequent reports. At the close of the week, however, there was a rally. The market was also influenced by the Equitable Life complications, less favorable crop reports and the inception of the state tax on stock sales, which went into operation during the week. The Supreme Court's decision sustaining the New York franchise tax was discounted and the traction group failed to decline materially on it. Electric stocks showed some firmness and while no unusual amount of business was transacted in any single case, prices showed a stiffening tendency. Allis-Chalmers preferred is a fraction higher, closing at 51⅛. General Electric also made a fractional gain, closing at 173¼ after reaching 175. Westinghouse closed at 166, which is a net gain of 1 point. Among the tractions Brooklyn Rapid Transit showed the greatest activity, 183,700 shares having been sold; the closing price was 63¾, which is a net gain of 5⅛. Metropolitan Street Railway gained 3⅛ points, closing at 118⅝. Interborough Rapid Transit closed at 200½, a net loss of 1½ points. Western Union was quiet, closing at 93, which is a net gain of ¼ point. The curb market was without special feature, the volume of business being reduced. Following are the closing quotations of June 6:

NEW YORK

	May 29	June 6		May 29	June 6
Allis-Chalmers Co.	13⅛	14	Electric Vehicle pfd.	18	20¼
Allis-Chalmers Co. pfd.	51	51	General Electric	173⅜	172
American Tel. & Cable	90	90	Hudson River Tel.	..	..
American Tel. & Tel.	138	139	Interborough Rap. Tran.	200⅛	201
American Dist. Tel.	28½	28	Metropolitan St. Ry.	116⅝	118⅞
Brooklyn Rapid Transit	61	62⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	30	30	Western Union Tel.	92⅛	92⅛
Electric Boat pfd.	74	73	Westinghouse com.	165	164
Electric Lead Reduction	..	..	Westinghouse pfd.	..	..
Electric Vehicle	12	16			

BOSTON

	May 29	June 6		May 29	June 6
American Tel. & Tel.	138¼	139	Western Tel. & Tel. pfd.	98	*98
Cumberland Telephone	118⅜	119	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum.	*246	*245	New England Telephone	136¾	137¼
General Electric	171⅛	173	Mass. Elec. Ry.	16	16
Western Tel. & Tel.	*18	*17¼	Mass. Elec. Ry. pfd.	59	58½

PHILADELPHIA

	May 29	June 6		May 29	June 6
American Railways	51	50	Phila. Traction	..	..
Elec. Storage Battery	76	75	Phila. Electric	9⅞	8⅝
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	30¾	27½
Elec. Co. of America	11¼	11¼			

CHICAGO

	May 29	June 6		May 29	June 6
Central Union Tel.	..	.	National Carbon pfd.	117	116
Chicago Edison	..	..	Metropolitan Elev. com.	22	23
Chicago City Ry.	190	..	Union Traction	..	..
Chicago Tel. Co.	..	..	Union Traction pfd.	..	..
National Carbon	60	60			

* Asked.

AN EXTRAORDINARY LIGHTING COMPANY.—The identity of the persons connected with the Anti-Monopoly Light and Power Company was made public last week when the incorporation papers were filed. The company was incorporated at Albany, and immediately after a mortgage was executed covering all right and title in a half interest in its franchise for $350,000,000. The company is capitalized at $100,000, and its franchise has lain dormant for eighteen years. Some curious details of it are given by the *New York Tribune*. George B. Hayes, the president, and John L. Walsh, the secretary, executed the mortgage to William N. Baron, of Jersey City, as trustee, for an issue of $350,000,000 5 per cent gold bonds, payable July 1, 1947, on which no interest is to be paid for the first five years. Besides the half interest in the franchise, which was granted by the Board of Aldermen in May, 1887, to the American Electric Manufacturing Company, the mortgage also covers all right and title in a half interest in a patent arc light and all interest in a contract made May 23, 1905, between the Anti-Monopoly Light and Power Company and John J. Moore to erect buildings in this State, but it is the franchise which makes these of any value. George B. Hayes, president of the new company, owns 988 shares of the capital stock, the two directors, Albert G. Stephenson, of No. 60 West 76th Street, and John L. Walsh, of No. 306 East 37th Street, who is also the treasurer, holding a single share each. The new company is the successor of the American Electric Manufacturing Company, which the New York Edison company has been trying to absorb for the last five years because of this valuable franchise which it held from the Board of Aldermen, approved by Mayor Hewitt. The mortgage just secured is said to be preliminary to developing the franchise. It is said also that the arc light patent has been renewed and that the company will begin operations at once. The articles of incorporation state that the company is formed "to manufacture, use, produce, buy and vend electricity for light, heat or power, lighting the streets, parks and public or private buildings in the cities of New York, Yonkers, Poughkeepsie, Albany, Troy, Utica, Syracuse, Rochester, Buffalo, Plattsburg, Binghamton, Auburn and Elmira." It also proposes to "make and vend gas, steam, hot air and all other gaseous fluids."

NEW YORK CITY RAILWAY.—The consolidated statement of earnings and expenses of the New York City Railway system (including all lines owned or controlled) for the nine months ended March 31, 1905, compares as follows:

	1905.	1904.	Changes.
Gross	$13,490,318	$13,277,838	Inc. $212,480
Expenses	7,610,899	7,017,817	Inc. 593,082
Net	$5,879,419	$6,260,021	Dec. $380,602
Other income	900,080	952,684	Dec. 52,604
Total income	$6,779,499	$7,212,705	Dec. $433,206
Charges	8,703,876	7,854,863	Inc. 849,013
Deficit	$1,924,377	$642,158	Inc. $1,282,219

NEW LIGHTING COMPANIES.—A special dispatch from Albany, N. Y., of May 31 says: "Judging from the large number of electric light, heat and power companies which have been incorporated with the Secretary of State since the Legislature passed the proposed law establishing a State Lighting Commission, it is apparent that the commission will have little to do for some years to come in connection with the approval of the formation of this class of corporations. Over fifty of these corporations have been formed since the bill passed the Legislature and not a section of the State has been left uncovered. Three more were incorporated to-day."

DIVIDENDS.—The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent., payable June 30. Chicago City Railway Company has declared the regular quarterly dividend of 2¼ per cent., payable June 30. Directors of the Safety Car Heating & Lighting Company have declared the regular quarterly dividend of 2 per cent and an extra dividend of 1½ per cent on the outstanding stock, payable July 1. The United Railways & Electric Company, of Baltimore, has passed the dividend on the preferred stock and the interest on the income bonds.

TELEPHONE STOCK LISTINGS.—Recent listings on the St. Louis Stock Exchange include $2,000,000 capital stock of the Kansas City Home Telephone Company, most of which is held in St. Louis; also $1,290,000 bonds and $1,250,000 stock of the Toledo Home Telephone Company, Toledo, O. Both are in the chain of independent telephone companies extending from Pittsburg to Kansas City.

LIGHTING IN WESTCHESTER, N. Y.—F. A. Stratton, president of the Westchester Lighting Company, has bought outright the Northern Westchester Lighting Company. The company furnishes light to Ossining, Briarcliffe Manor, Pleasantville, Croton and villages throughout the northern section of the county. Five Westchester national banks have subscribed to the bonds of the company.

LONG ISLAND TRACTION DEAL.—The New York & Long Island Traction Company has sold out its entire plant to Sanderson & Porter, of New York City. The company controls thirty-four miles of track from Mineola to Jamaica. Its capital stock is $1,000,000 and bonded indebtedness $500,000.

THE MEXICAN LIGHT & POWER COMPANY, City of Mexico, has purchased the San Ildefonso Lighting Company, of Mexico, and will ask for jurisdiction to issue twenty million dollars consolidated first mortgage bonds to put through the purchase.

General News of the Week

The Telephone.

LOS ANGELES, CAL.—The Los Angeles-Pacific electric railway is preparing to displace telephony with telegraphy along its tracks as means of communication between the several stations and in train dispatching. Copper wires for the use of the new telegraph line are now being strung and telegraph offices will be established at all stations along the route.

ATLANTA, GA.—The returns of the Southern Bell Telephone Company in the State of Georgia for the present year are $1,072,630, showing an increase over the year before of $165,841.

METAMORA, ILL.—The Metamora Telephone Company of this city has dissolved.

COWDEN, ILL.—The Cowden Mutual Telephone Company, capital $2500, has been incorporated by Seachery Hodson, Frank Bunn and others.

RANSOM, ILL.—Ransom's village board has granted the American Telephone and Telegraph Company the right to construct and operate a telephone line in this village.

ALTON, ILL.—At a meeting of the stockholders of the Star Telephone & Telegraph Company it was voted to increase the capital stock of the company from $2,500 to $12,500.

WATERLOO, IND.—The Central Union Telephone Company has bought the independent service of Wells, Grant, Blackford and Huntington counties.

INDIANAPOLIS, IND.—It is stated that the 5000 telephones controlled by the United States Telephone Company at Indianapolis will hereafter be operated in connection with those of the Central Union Telephone Company.

MICHIGAN CITY, IND.—The North Judson Telephone Company has purchased the San Pierre Telephone Exchange. This company is now the owner of the San Pierre, Lacrosse, Wilder, Riverside, Dunnville and Farm Siding telephone systems.

BROOKVILLE, IND.—The Brookville Telephone Company has authorized the issue of $5,000 preferred stock bearing 5 per cent., payable semi-annually. The company contemplates extensive improvements. John C. Shirk is president, and M. H. Irwin, secretary.

DUPONT, IND.—The Independent Telephone Company, of Lancaster and Monroe Townships, Jefferson County, has filed articles of incorporation with the secretary of state. The capital stock is $5,000. David H. Bentley, L. F. Healton, F. C. Cuny and I. W. Wood are directors.

OSAGE, IA.—The two telephone systems at Osage are about to consolidate.

BURLINGTON, IA.—The Burlington & Augusta Telephone Company nas increased its capital to $25,000.

GRIMES, IA.—The Farm Mutual Telephone Company has filed an amendment increasing its capital to $40,000.

DES MOINES, IA.—The Doon and Alvord Telephone Company has been chartered; capital $500. The incorporators are August Berg and others.

ALVORD, IA.—The Cleveland Township Telephone Company, of Alvord, has been formed; capital, $700. The incorporators are Frank Donnelly and others.

DES MOINES, IA.—The Bremer and Black Hawk Mutual Telephone Company has been formed; capital, $10,000. D. G. Boomer and others are the incorporators.

MAQUOKETA, IA.—Otto Wettenstein, the new owner of the Maquoketa Telephone Company, has been making arrangements for the reconstruction of its lines and the placing of a new switchboard.

DUBUQUE, IA.—The Standard Telephone Company is making preparations to build a copper trunk line across the State from Dubuque to Sioux City. The new State Telephone Company at Sioux City and the leading companies between the two cities will co-operate.

SIOUX CITY, IA.—The directors of the New State Telephone Company, having charge of the toll business to be operated in connection with the new automatic system of the Sioux City Telephone Company, have been devising ways and means for beginning the construction of independent telephone lines into Sioux City. The directors are Charles G. Cockerill, of Jefferson, Ia., president; P. C. Cockerill, of Jefferson, Ia., superintendent of construction; C. H. Smith, of Odebolt, secretary Ira Conger, Cherokee A. Marquis, of Onawa; W. H. Leathers, of Mapleton; J. C. Hammond, of Mapleton and M. M. Head, of Jefferson.

MARVIN, KAN.—The Citizens' Telephone Company of this city has been formed; capital, $1,000.

EMPORIA, KAN.—The Bell and the independent telephone officers here have completed arrangements for consolidation.

PADUCAH, KY.—The Paducah Independent Telephone Company has been sold to a syndicate of capitalists who are interested in the Home Telephone Company, of Louisville.

NEW IBERIA, LA.—This city is to have a new telephone company. General Manager Daniel Baker of the Bertha Telephone & Telegraph Company has made preliminary arrangements to enter the city and build an exchange. The company's idea is to continue the line direct into New Orleans, affording a competing line. The company is now making the circuit to embrace all the towns lying north of this parish.

PORTLAND, ME.—The Champlain Valley Telephone Company has been organized at Portland; capital stock, $150,000, $110 paid in, par value $10. The promoters are F. W. Story (president), Boston, Mass.; M. B. Jones (treasurer), Newton, Mass.; W. H. Davis, Middlebury, Vt.; A. W. Foote, Cornwall, Vt.; M. F. Delano, East Shoreham, Vt.; Charles H. Adams, John C. Kilday, Robert H. Duncan, C. E. McLaughlin, B. L. Steward, H. L. Cram.

BAY CITY, MICH.—The Northeastern Telegraph & Telephone Company, which operates telephone wires from Bay City to Alpena and Cheboygan and north nearly to Mackinaw, to which it is building, has filed in Wayne County a trust mortgage for $150,000 to secure a bond issue of that amount. The money raised is to be used in extending the system in the various counties north. The company makes connections here with the Michigan State Telephone Company.

GRANITE FALLS, MINN.—The Granite Falls Telephone Company has been organized with $50,000 capital stock.

WILMAR, MINN.—At a meeting of the Minnesota Central Telephone Company, the following officers were elected: President and treasurer, D. N. Tallmann; secretary, John Williams.

BIRNEY, MONT.—A telephone line to Sheridan, Wyo., is projected by W. H. Walling, of Decker, and others.

DILLON, MONT.—The Southern Montana Telephone Company has been organized here with a capital stock of $5,000. Bids for the construction of lines from this city to all parts of the Big Hole country will be asked for in a few days. B. F. White of this city is chief promoter of the enterprise.

BILLINGS, MONT.—The management of the Rocky Mountain Bell Telephone Company announces that a line will be constructed in the next few months between here and Miles City, placing that city, through Billings, in communication with all points in the Bell system in Montana, Idaho, Utah and Wyoming.

MARVIA, MO.—The Citizens Telephone Company of this city has been incorporated with a capital of $1,900.

PRAIRIE HOME, MO.—The Farmers' Telephone Company of this city has been incorporated with a capital of $3000. The incorporators are: William H. Ellis, Louis Ehaddt and others.

GOLDFIELD, NEV.—A consolidation of all the telephone and telegraph lines in the mining belt of southern Nevada, excepting the new wire of the Western Union Telegraph Company, has been effected, the new incorporation to be known as the Southern Nevada Telephone & Telegraph Company. The officers are: Malcolm L. Macdonald, president; Key Pittman, vice-president; F. Y. Williams, secretary, treasurer and general manager, with J. D. Lathrop, John McKane, Thomas B. Hall and T. L. Oddie as directors.

CLEVELAND, OHIO.—The Independent Telephone Company of Lancaster and Monroe Townships has been formed, capital $500. The incorporators are J. W. Rector, J. B. McConnell.

TOLEDO, OHIO.—The Central Union Telephone Company has closed a contract with the Toledo, Fostoria & Findlay Electric Railway Company to furnish twelve telephones to be placed upon the railway's private line and to be connected with the switchboards at Fostoria and Findlay.

SHAWNEE, OKLA.—The City Council has granted to F. G. McElroy, of Dallas, a franchise to erect and maintain a telephone system here.

LAKEVIEW, ORE.—The Dent Telephone & Telegraph Company will run a lipe from Lakeview to Blush, via Grand Lake and Adel, which will traverse a large territory. C. W. Dent is the original promotor.

NASHVILLE, TENN.—The Big Buck Telephone Company, of Green County, has been chartered; capital, $200. Incorporators are Cleveland Justice, Samuel Malone and others.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company has decided to establish a telephone on a buoy in the Great Salt Lake, 300 feet from the pavilion. This is designed as a means of warning bathers.

BALLARD, VA.—The Ballard Telephone Company has been chartered by the State, with E. J. Hylton, president, and J. E. Hylton, secretary and treasurer. The capital stock is $5,000.

COURTLAND, VA.—The Southampton Telephone Company, of Cortland, has been chartered with T. A. Saunders, president, and F. P. Pulley, vice-president, the capital being $5,000 maximum.

PALMYRA, VA.—The Virginia Central Telephone Company, of Palmyra, has been chartered with $5,000 capital. The incorporators are: C. E. Jones, president; L. O. Haden, secretary, and other officers and stockholders.

TACOMA, WASH.—Louis Morrison and Dell Keagy, of Chambers Prairie, have applied to the County Commissioners for franchise to operate rural telephone line between this city and Chambers Prairie.

GOLDENDALE, WASH.—At a meeting composed of representatives of the different granges around Goldendale, a new farmers' mutual telephone company was organized. A committee was appointed to communicate with the Bell Telephone Company to ascertain on what terms it could connect with one of its switchboards.

MOUNT VERNON, WIS.—The Mount Vernon Telephone Company has been formed; capital, $10,000. G. G. Stamp is president.

GUELPH, CAN.—A system of telephones has been installed in the Grand Trunk yards at the Junction, by which the handling of trains will be rendered much more convenient. Difficulty has always been experienced in the location of cars and the arrangement of trains, but the new system, which is the sugtion of Mr. J. J. Forbes, the local agent, will remove future troubles.

Electric Light and Power.

BLANCHE, ALA.—H. T. Henderson, of Durango, Col., is interested in the construction of a water power plant on Little River in Cherokee County.

TALLADEGA, ALA.—Power has been turned on from the new plant at the shoals on Chocolocco Creek. The city will, in the future, be lighted from this plant, and power furnished manufactories. Engineers estimate that 5,000 horse-power is available from this point.

WINSLOW, ARIZ.—At a recent special election the people voted in favor of granting a franchise for electric light and power purposes to the Winslow Electric Light & Power Company.

WARREN, ARK.—The Warren Light & Water Co. has contracted with a local manufacturing company for water and electricity, and will only have to wire and pipe the town, and is now ready for bids for the material required for this work; the probable cost of work is $12,000.

FT. BRAGG, CAL.—The Ft. Bragg Electric Light Co., Inc., has applied for a franchise to construct and operate an electric plant for generating electricity to furnish heat, light and power for the city. Bids for said franchise will be received June 26 by the Board of Trustees. Sam J. Zerbt is clerk.

SAN FRANCISCO, CAL.—President H. L. Shannon says that the Shasta Power Company has a force of 75 men at work at its power site, near Bear Creek Falls, Shasta County, 24 miles east of Redding. All materials will be delivered promptly, and it is expected that the first unit of 1500 horse-power will be installed in September next. The plant is in the center of the great copper belt mining and smelting region.

SAN FRANCISCO, CAL.—The Washoe Power & Development Company's water power electric plant, located ten miles east of Reno, Nev., is in operation, transmitting to Reno and to Sparks, 12 miles. A distributing system has been installed for light and power purposes. The initial installation includes a Stanley 750-kw., three-phase generator, direct connected to a water wheel. Specifications have been issued for an additional 750-kw., three-phase generator for the same plant by Cory, Meredith & Allen, engineers, who will receive bids at their offices, 331 Pine Street.

SAN FRANCISCO, CAL.—The Oceanside Electric Light Company, which has been incorporated with a capital stock of $20,000 by R. H. Fitzgerald, J. T. Boyd, H. B. Young, J. H. Brenner and J. D. McGown, will erect an electric generating plant near the ocean beach in San Francisco. It is said that many contracts have been signed for lighting current for terms of three years at 10 cents per kw-hour. R. H. Fitzgerald is president of the company; J. H. Brenner, secretary, and J. T. Boyd, general manager. The ocean beach district, extending several miles south of the Cliff House, is building up rapidly, and the nearest lighting plant is six miles distant. It is said that Los Angeles capital is behind the new enterprise.

DENVER, COL.—It is proposed to build a subway on, probably, Sixteenth St., in this city, and place the overhead wires therein.

SHARON, CONN.—The Sharon Electric Light Company has received permission to operate in Canaan and North Canaan.

WILMINGTON, DEL.—Mayor Bird has expressed himself in favor of a municipal lighting plant.

MONTICELLO, GA.—The citizens have voted to issue $30,000 bonds for an electric light plant, water works and sewerage system.

SAVANNAH, GA.—A $50,000 subway has been completed in Savannah by the Savannah Electric Company, the Atlantic Coast Line and the city.

SAVANNAH, GA.—The Savannah Lighting Company is in the field for the franchise for municipal lighting against the Savannah Electric Company, which now has possession of the field and franchise.

COLUMBUS, GA.—It is stated that the Westinghouse Electric & Mfg. Co. is preparing plans, specifications and estimates for the construction and equipment of the Chattahoochee electric plant for Stone & Webster, of Boston, Mass.

COVE, IDA.—The power plant being installed in this city is nearly completed and is expected to be furnishing energy for electric lights in the Grande Ronde country by July 1.

CRAWFORDSVILLE, IND.—The Water & Light Co. has decided to expend about $125,000 in improvements.

WASHINGTON, IND.—The Town Trustees contemplate installing 150 enclosed arc lights to take the place of the open lights now in use. M. A. Roberts is superintendent.

ANDERSON, IND.—A number of farmers living within a radius of six miles have petitioned the City Council to be connected with the municipal electric light plant. The city authorities look favorably on the request. The electric light plant has been enlarged and has a surplus of power which can be utilized in this way. The farmers have agreed to furnish the poles.

WYNNEWOOD, IND. TER.—It is proposed to vote on issuing bonds for the construction of water works and an electric light plant, but nothing definite has been done, except to appoint a committee to figure cost, etc. J. H. Boozer is city recorder.

ALDEN, IA.—It was voted to grant an electric light franchise to the Peterson Heat, Light & Water Co. C. A. Daw, Iowa Falls, is the engineer.

CHETOPA, KAN.—The citizens have voted to issue bonds for water works and an electric light plant.

PADUCAH, KY.—The Paducah Gas & Electric Company has been sold by Thomas Coffee to James C. Utterback for $135,000.

ABBEVILLE, LA.—Bids will be received by the Board of Aldermen July 3 for the purchase of $40,000 bonds to be used for the construction of water works, sewerage system and electric light plant. George W. Summers is secretary.

BANGOR, ME.—Arrangements have been completed whereby Farson, Leach & Co., of New York, will finance the development of the Bodwell Water Power Company, at Old Town and Milford. The development of the water power will be for the purpose of establishing a plant for the supplying of electrical power. An electrical transmission line will be built from Old Town to Bangor, and a transformer station built at the mills at South Brewer. The power station will be built on the Milford side of the river, 1,500 feet below the present Milford mills. The amount to be expended in the development of this property will be more than $1,000,000.

ELLICOTT CITY, MD.—Victor G. Bloede, of Baltimore, treasurer Patapsco Electric & Manufacturing Company, writes that it is proposed to construct a plant on the Patapsco River, below Ellicott City, for the purpose of generating electric current for light and power. The approximate capacity of the power plant will be about 900 horse-power. The design of the building has not yet been made, nor has the make of machinery been decided upon.

BOSTON, MASS.—The gas commissioners have authorized the United Electric Light Company of Springfield to issue 2,000 additional shares of capital stock at $260 per share; 820 shares will be used to take up notes and the remainder, 1,180 shares, will be applied to additions to plant.

QUINCY, MASS.—The Massachusetts Electric Light and Gas Commissioners have given a hearing at the Quincy City Council chamber on the petition of Henry L. Kincaide and others of that city, asking for a reduction in the prices charged by the Quincy Electric Light & Power Company for electricity within the limits of that city. Chairman Barker stated the board would take the case under advisement, and in the mean time would compare the prices charged by the Quincy Company with those charged in other cities and towns.

HUDSON, MICH.—The Hudson Electric Light Company has been formed with $25,000 capital.

REPUBLIC, MICH.—The citizens have voted to issue $20,000 bonds for water works and an electric light plant.

TRENTON, MICH.—The village electric light plant and water works were destroyed by fire May 28. D. H. Reaume is chief engineer.

STARKVILLE, MISS.—Bonds to the amount of $8000 have been sold, the proceeds to be used for enlarging the water and light plant.

DURANT, MISS.—J. G. Hamilton, Mayor, writes that it is proposed to replace the present electric light plant with a larger plant, at a cost of $12,000. Bids for construction will be received about July 3.

WISNER, NEB.—Bids will be received June 26 for the purchase of $9,000 bonds, to be used for the construction of a lighting plant. It has not yet been decided what kind of a lighting plant will be constructed.

LEBANON, N. H.—The Lebanon Electric Light Company has purchased of George S. Rogers what is known as the Chancellor water privilege on the Mascoma River also the water power between the two bridges below. The fall is 22 feet, which will produce about 200 horse-power. It is the last available water privilege on the river near this place. The electric light company will not utilize the power at present, but may arrange to do so later.

PATERSON, N. J.—The Paterson Electric Light, Heat & Power Company has petitioned Council for a franchise for an electric light plant.

NEWARK, N. J.—President Eggers, of the Board of Works, wants the city to have its own lighting plant and save the $260,000 now spent for street lighting.

POTSDAM, N. Y.—The Hydraulic and Electric Power Company has been formed at Potsdam; capital, $50,000. Directors: G. W. Sisson, R. L. Sisson and C. H. Sisson, Potsdam.

SOUTHOLD, N. Y.—The Southold Lighting Co. has been incorporated with a capital of $6,000 by Jos. H. Marshall, Frank R. Mitchell, Lester Albertson and others of Southold.

ALDEN, N. Y.—The Alden Lighting, Heating & Power Company has been incorporated with a capital stock of $200,000. The directors are F. G. Bagley, A. L. Becker, D. E. Klein, Buffalo.

ALBANY, N. Y.—The Hudson River Power Co. is said to be preparing to increase its capacity by the construction of a dam across the Sacandaga. It also proposes building dams on the Schoharie.

NEW YORK, N. Y.—The New York & Lake Erie Power & Transmission Company, of Erie County, has been formed; capital, $100,000. Directors: J. F. Aldrich, G. A. Ricker and C. F. Powell, of Buffalo.

ALBANY, N. Y.—The Anderson Power Transmission Company has been incorporated with a capital stock of $15,000. The directors are John P. Brooks, A. Warner Brooks, Charles S. Hoose, Albany.

CAZENOVIA, N. Y.—The Cazenovia Electric Company has been incorporated with a capital of $30,000 by Henry Burden and Robt. F. Hubbard, of Cazenovia, to manufacture electricity for light, heat and power.

NEW YORK, N. Y.—The River Counties Lighting Company has been incorporated with a capital stock of $5000. The directors are R. S. Hull, Brooklyn; W. F. Judson, Irvington-on-the-Hudson; John Larkin, New York.

ALBANY, N. Y.—The Southern Tier Power & Transmission Company has been incorporated with a capital stock of $200,000. The directors are H. M. Merrihew, New York; Harrison Williams, Buffalo; H. A. Taylor, Upper Montclair, N. J.

LAKE PLACID, N. Y.—This village proposes constructing a masonry dam on the west branch of Ausable River and developing a water power with a 35-ft. head for operating the municipal electric light plant. A 125-hp., high-speed engine will also be installed, to be used at low water only. It is also proposed to construct a 5,000,000-gal. reservoir and a pumping plant. The pumping plant will have a power pump driven by electric motor and a steam pump, each pump to have a capacity of 1,500,000 gals. in 24 hours. Chas. E. Collins, Drexel Building, Philadelphia, Pa., is the engineer.

BATAVIA, N. Y.—The Genesee County Electric Power & Gas Company, of Batavia, has been incorporated with a capital of $100,000. The incorporators are Simon B. Storer, of Syracuse; Raymond M. Walker and C. Clifton Bradley, of Batavia.

NEW YORK, N. Y.—The All Counties Gas, Electric Lighting, Power, Heating & Illuminating Company has been incorporated with a capital stock of $10,000. The directors are F. R. W. Potter, Flatbush, L. I.; H. E. Gates, A. C. Cooper, Brooklyn.

HOOSICK FALLS, N. Y.—The Hoosick Falls Illuminating Company has been incorporated to supply gas and electricity, with a capital stock of $150,000. The directors are Roger Lewis, L. C. Tetard, Sherman Cox, R. W. Gifford, of New York, and G. D. Martin, of Greenwich, Conn.

ALBANY, N. Y.—The Racquette River Transmission Co. has been incorporated with a capital of $50,000 to manufacture electricity for light, heat and power in Albany, Rensselaer, Columbia, Saratoga, Green, New York and Kings Counties. The incorporators are Leroy S. Bradford, of Broadalbin; Lorenzo N. Rider, of Bath, and others.

BUFFALO, N. Y.—The Economy Light, Fuel & Power Company has been incorporated with a capital of $250,000, to furnish gas, electricity and steam in the cities of Buffalo and Lockport and in Erie and Niagara Counties. The incorporators are: Isaac H. Babcock and Burt Hall, of Lockport; B. F. Seadler, of New York City, and others.

NIAGARA FALLS, N. Y.—The International Power & Transmission Company, of Niagara Falls, has been incorporated with a capital of $2,000,000 for the purpose of supplying electricity for light, heat and power purposes. The directors are S. P. Franchot, J. S. Simmons, F. J. Brown, Clarence Tower, John F. Lynch and H. H. Findlay of Niagara Falls.

QUEENSBURY, N. Y.—The Adirondack Power Company has been incorporated with a captal of $200,000, to supply electric light and power in Albany, Essex, Fulton, Hamilton, Montgomery, Rensselaer, Saratoga, Washington and Warren Counties. The directors are: Geo. F. Underwood and Fred. H. Parks, of N. Y. City; Geo. R. Finch and Maurice Hoopes, of Glens Falls. The principal office will be in Queensbury.

KENTON, OHIO.—Kerlin Bros., of Toledo, have purchased the plant of the Kenton Gas & Electric Company. It is reported that $50,000 will be expended in improvements.

RICHLAND, ORE.—C. F. Hyde and W. H. Strayer, of Baker City, are interested in the construction of an electric light plant at Richland.

YORK, PA.—It is stated that Bertram, Storrs & Griscom, of New York, N. Y.; Lee, Higginson & Co., of Boston, Mass., and other banking interests, have financed the project of constructing a power plant on the Susquehanna River at McCalls Ferry.

WILKESBARRE, PA.—The Wilkesbarre Gas & Electric Company contemplates improving its plant, to include changing from direct current to alternating current; adding apparatus of 1,350 kw. to station capacity; one Curtis turbine, and changing from non-condensing to condensing.

EASTON, PA.—Under a charter granted to the Consolidated Service Company, of Easton, Pa., a merger of the People's Electric Light and Power Company and the Easton Steam Heating Company has been effected. The charter for the new company, which is capitalized at $200,000, the sum of the capitalizations of the two present corporations, was signed by Governor Pennypacker, May 18. The officers for the new company named in the charter are E. W. Evans, president, and Henry G. Siegfried, secretary and treasurer.

PROVIDENCE, R. I.—The J. & P. Coats Company, Ltd., has plans well under way for the erection of an electric power station on the property owned by the company, which adjoins the Pawtucket River. This means the substitution of electric for steam power.

DILLON, S. C.—It was voted June 1 to accept the franchise recently granted to A. N. Walker and associates for water works and an electric light plant.

CHATTANOOGA, TENN.—The Chattanooga-Tennessee River Power Co. has filed a petition for a charter for the purpose of improving and developing the water powers of rivers and streams in the State of Tennnessee and especially of Tennessee river in Hamilton and Marion Counties; also for the purpose of manufacturing, selling and distributing electricity. The incorporators are Chas. E. James, Jos. C. Guild, Norris Headrick and others.

DALLAS, TEX.—The citizens have voted to issue bonds to the amount of $100,000 for an electric light plant.

DEL RIO, TEX.—The Del Rio Electric Light & Ice Company has been incorporated with a capital of $20,000. The incorporators are: J. D. Darden, of Jericho; John M. Gray, of Del Rio, and Maynard Gunsel, of Albuquerque, New Mexico.

PARK CITY, UTAH.—The Summit Electric Company has been formed with a capital of $100,000 by Henry Shields, Willard F. Snyder and others, of Salt Lake City, to distribute electric light and power in Park City.

SALT LAKE CITY, UTAH.—The proposed new franchise of the Utah Light & Railway Company, extending its various franchises so that all will terminate in fifty years, has been practically defeated in the City Council by its reference back to the city attorney. The eight Gentile members voted solidly for the reference, while the seven Mormons in the Council favored the light and railway company. The Gentile members have pledged themselves to continue to fight the proposed franchise.

JANESVILLE, WIS.—The contract for lighting the city has been awarded to the Janesville Electric Company, of Janesville, at $62 per light per year for 200 or more arc lights.

REGINA, N. W. T.—The city of Regina, N. W. T., Canada, will receive bids up to, and including, June 19, for $160,000 of water works, sewerage and electric light debentures. The debentures will be repayable in equal annual instalments over a period of fifty years, and will bear interest at 4½ per cent.

The Electric Railway.

HUNTSVILLE, ALA.—The Nashville & Huntsville Interurban Railway is now a practical certainty and construction work is scheduled to begin in early fall. A mass meeting of citizens was held here, at which time Ed. M. Sweeney and J. H. Conner, of Nashville, and S. E. Wight, of New York, submitted propositions for the building of the road. They stated that all the money necessary is at their command to build the road, but they desire that the business men and farmers along the projected route take a small amount of stock. This county was asked for $60,000, and there is hardly any doubt but that the amount will be raised. T. W. Pratt, F. J. Thompson and Clarendon Davis were appointed a committee to secure rights of way and subscriptions.

NORWICH, CONN.—The Legislature has passed a bill incorporating the Norwich, Jewett City & Voluntown Street Railway Company.

LEWISTON, IDA.—Construction work has been commenced on the proposed railway system of the Lewiston & Southeastern Electric Company. The undertaking will involve an expenditure of not less than $250,000.

BLOOMINGTON, ILL.—A franchise has been granted to the Peoria, Bloomington & Champaign Traction Company. Lines will be built from this city to Peoria and Decatur.

QUINCY, ILL.—The Chicago General Construction Company, of Chicago, has the contract to build the road between Quincy and Hannibal, Mo. The company has not yet decided whether to construct the power house at Quincy or Hannibal. The power house will cost about $80,000.

COLUMBIA CITY, IND.—The board of directors of the Huntington, Columbia City & Northwestern Electric Railway has closed a contract with the American Engineering Company, of Indianapolis, for the construction of the line.

BANGOR, ME.—The Bangor Railway & Electric Company, of Bangor, has voted to increase the par value of a share from $25 to $100, and to increase the capital stock to $1,000,000.

BOSTON, MASS.—The City of Cambridge has prepared a bill in connection with the Boston Elevated Railway Company to be submitted to the Massachusetts Legislature asking that the Boston Elevated be given authority to construct and operate in the City of Cambridge a four-track subway from the vicinity of Kendall Square through Main St. and Massachusetts Avenue or thereabouts to a point near Harvard Square. The city would have the right to purchase the subway after 20 years of use, provided it suitably reimbursed the railway company.

JACKSON, MICH.—A special dispatch from Jackson, Mich., says that eastern capitalists, including Charles B. Holt of New York, H. L. Randal of New Milford, Conn.; Charles Barlow of New Haven, E. H. Spaulding of New London, and Abram Paradise of Brooklyn, have decided to finance a trolley line to be built between Jackson and Adrian, Mich. The new line will connect at Adrian with the Toledo & Western. The Adrian-Jackson line will be operated in conjunction with other lines, so as to allow through cars from Toledo to Lansing, Mich.

NEW YORK, N. Y.—The Bronx, Yonkers & White Plains Railway Company has made application to the State railroad commission for a franchise for an electric railway from the Bronx to White Plains and Yonkers.

JELLICO, TENN.—The Jellico Electric Railway Company has effected a preliminary organization for the purpose of obtaining a charter. Capitalists of Jellico and Knoxville are interested in this new enterprise.

CHARLOTTE, N. C.—President E. D. Latta of the Charlotte Electric Railway system is seeking to secure through the courts a clear title to certain water rights purchased at Mountain Island, N. C.

WILMINGTON, N. C.—It is reported that Hugh MacRae, of Wilmington, is interested in a very extensive scheme to build electric railways to numerous points within a distance of 20 to 30 miles of Wilmington, and that large developments are being anticipated by the promoters of the scheme.

NEWARK, OHIO.—The Newark, Martinsburg & Mount Vernon Traction Company, formed to build a line from Newark to Mount Vernon, has organized with the following-named officers: President, E. H. Everett; vice-president, Dr. J. F. Schrontz; treasurer, J. A. Chilcote; counsel, Edward Kibler.

COLUMBUS, OHIO.—A merger has practically been completed for traction lines between Columbus and Indianapolis, and through dining and sleeping car service will be introduced. This is the first important step in a traction system that is to connect Pittsburg and St. Louis. It is being promoted by the Widener-Elkins syndicate, of Philadelphia, which is investing millions in traction property in the Central West.

CINCINNATI, OHIO.—The Ohio Traction Company, of Cincinnati, has been incorporated under the laws of Ohio, with a capital stock of $20,000,000. The incorporators are W. Kesley Schoepf, W. S. Rowe, W. C. Proctor, Briggs S. Cunningham and W. T. Irwin. The charter gives power to lease, own, and operate street and interurban roads in and between Cincinnati and Hamilton. Thomas Dolan, Randall Morgan, P. A. B. Widener, and George W. Elkins, of Philadelphia, are on the board of directors.

PORTLAND, ORE.—It is said that a deal has practically been closed by which D. O. Mills and Frank J. Brown, of San Francisco, have sold to Pennsylvania capitalists the Portland Consolidated Street Railway Company for $5,000,000.

CATAWISSA, PA.—A charter has been granted to the Catawissa & Numidia Electric Railway. The officers of the company are: President, C. E. Randall; treasurer, William M. Vastine.

NORRISTOWN, PA.—The Lansdale & Norristown Electric Railway, including franchises and all other property, real and personal, has been sold at public auction to Gen. W. E. Doster, counsel for the Lehigh Valley National Bank, of Bethlehem, for $150,000.

CHARLOTTESVILLE, VA.—The Albemarle & Farmville Railway Company, of Charlottesville, has been chartered with $25,000 capital and has the right to make use of any motive power desirable in operating the road.

WINCHESTER, VA.—The directors of the Winchester & Washington City Electric Railway announce that they have selected N. Wilson Davis, of Harrisonburg, to make plans for the power house and dam to be erected along the Shenandoah River east of Winchester. Mr. Davis will also be chief engineer of the work.

SHERIDAN, WYO.—F. E. McClure and G. L. McFarlane of Pittsburg, Pa., are making investigations here with a view to the construction of a steam or electric railway connecting this city with Buffalo.

HAMILTON, ONT.—The Hamilton Terminal Railway Company is seeking a charter to build and operate an electric railway in connection with the business of the Hamilton Steel & Iron Company. The applicants include C. S. Wilcox, A. E. Carpenter and C. E. Doolittle, of Hamilton. The capital stock is $100,000.

New Industrial Companies.

THE MAINE DYNELECTRON COMPANY, of Lewiston, Me., has been organized with a capital of $1,000,000.

THE JOHN P. HOLLAND SUBMARINE BOAT COMPANY has been organized with a capital of $1,000,000. The Electric Boat Company is suing Mr. Holland for control of his later patents.

THE EDWARDS ELECTRIC HEADLIGHT COMPANY, of La Porte, Ind., has been incorporated. The capital stock is $250,000. Chas. A. Goodyear is president, and H. G. Leffling, secretary.

THE HYDRAULIC & ELECTRIC POWER COMPANY, of Potsdam, N. Y., has been incorporated with a capital stock of $50,000. The directors are G. W. Sisson, R. L. Sisson and C. H. Sisson, Potsdam.

THE NIAGARA & EASTERN POWER & TRANSMISSION COMPANY, of Niagara Falls, has been incorporated with a capital stock of $2,000,000. The directors are H. B. Bodin, J. D. Drayton, Niagara Falls, and A. H. Hinman, Buffalo.

THE MARQUETTE ELECTRIC MANUFACTURING COMPANY, of Chicago, has been formed; capital, $50,000; to manufacture electrical appliances and machinery for light and power. Incorporators: Henrry A. Weyhl, George Schein, Louis T. Orr.

THE BUFFALO & MONTAUK COMPANY has been incorporated at Buffalo, N. Y., with a capital of $2,000,000. The directors are Hugh Taylor, of East Aurora; Byron L. Moore, Anthony P. Harks, Fred E. Pond and James D. Ferris, of Buffalo.

THE MANNING, MAXWELL & MOORE COMPANY has been incorporated at Trenton, N. J., with an authorized capital of $5,000,000. The company is to manufacture and sell all kinds of machinery. The incorporators are John L. Griggs of Paterson, Colby M. Chester, Jr., of Greenwich, Conn., and Donald Holmes of Paterson. The principal office of the company is at Paterson.

Legal.

QUOTATIONS IN CHICAGO.—The Supreme Court of the United States in Washington has reversed the decree of the Circuit Court of the United States for the Northern District of Illinois, dismissing for want of jurisdiction the case of the Board of Trade of Chicago against the Hammond Elevator Company and the Western Union Telegraph Company, and remanded the case for further proceedings. The question involved is one of jurisdiction. The elevator company has its headquarters at Hammond, Ind., and contended that its "correspondents" in Illinois were not its "agents." The business of the company was to take orders for the purchase and sale of stocks and grain, the orders of customers being transmitted over the wires of the Western Union Telegraph Company from the various offices of "correspondents" to Hammond, Ind. The decision, which gives the Illinois court jurisdiction, was not concurred in by Chief Justice Fuller and Justices Harlan and Day.

MISSOURI & KANSAS TELEPHONE COMPANY.—The Supreme Court of Missouri has handed down an important decision vitally affecting the interests of the Missouri & Kansas Telephone Company. It is to the effect that the municipalities in that State cannot lawfully fix a rate at which telephone companies shall be obliged to furnish service. The city of Kansas City some time ago passed an ordinance fixing the maximum yearly rate for telephones at $60. The Missouri and Kansas Company, a Bell licensee, disregarded the ordinance, holding that it was unconstitutional. The Home Telephone Company, of Kansas City, a competitor of the Bell Company, was granted a franchise and has been waging strenuous warfare against the Missouri & Kansas Company, furnishing its service for $54. It now has between 10,000 and 11,000 subscribers, while the Missouri & Kansas Company has 14,000 subscribers at $96. A bill was recently brought by one James Garner to compel the Bell Company to furnish him telephone service at the maximum rate fixed by the city ordinance. The court in its opinion says: "I have reached the conclusion that it is no part of a municipality's power to regulate the prices that may be charged for telephone service any more than it is to regulate the price that may be charged for any quasi-public service, or for the sale of the necessities of life."

Obituary.

MR. J. M. MITCHELL.—The death is announced at Tuxedo Park, N. J., of ex-Congressman John Murray Mitchell. He was well known in electrical circles many years ago when active in the promotion and introduction of the Daft motor. He was prominent in New York social and political life for many years.

MR. E. A. LESLIE.—We regret to announce the death of Mr. E. A. Leslie, which occurred June 5 at his home in Brooklyn, from pneumonia and pleurisy, after an illness of some days. Mr. Leslie was born in Harrisburg, Pa., in 1849. Starting as a messenger boy he rose rapidly in the telegraph profession. While manager in New York of the Western Union Cable department, he was appointed in 1882 superintendent of the Mutual Union Telegraph Company, with headquarters in Washington. In 1884 he became superintendent of the National Telegraph Company and also superintendent of the Eastern Division of the B. & O. Telegraph Company, and in 1885 was appointed general superintendent of the latter division, with headquarters in New York. After a short connection with a storage battery company, he entered the employ of the Consolidated Telegraph & Electrical Subway Company, and in 1888 became manager of the Manhattan Electric Light Company, afterwards consolidated with the N. Y. Edison Illuminating Company, with which he remained until 1901, when he became general manager of the Kings County Electric Light Company, which position he had since occupied. Mr. Leslie had a large circle of friends in the National Electric Light Association, with the administration of which he was at one time prominently interested. At the time of his death he was secretary of the Association of Edison Illuminating Companies and a director and treasurer of the Electrical Testing Laboratories. Mr. Leslie impressed all with whom he came in contact as a man of strong character and personality, and whose friendship was enduring.

Educational.

THE INDIANAPOLIS TECHNICAL INSTITUTE is giving special attention to its electrical department, under the charge of Frank Seig. The electrical work consists of all kinds of house wiring, telephone wiring and installation and electric light wiring. The students have installed successful plants, including all those in the campus grounds.

Personal.

MR. FRANCIS H. SHEPARD, the elctric railway expert, is to married this month to Miss Margaret Livermore of Norwich, Conn.

MR. PAUL MORTON is to leave the Cabinet on July 1 and to become associated in a prominent capacity with New York City Railway interests, with special reference to underground railway work.

PROF. CLARENCE FELDMANN will resign the chair of electrical engineer at the Darmstadt, Germany, Electrotechnical High School to accept a similar position in the Polytechnische Institute at Delft, Holland.

MR. ROBERT McF. DOBLE, consulting engineer of the Abner Doble Company, San Francisco, is in Mexico for the purpose of investigating several important hydro-electric long-distance power projects.

MR. F. B. COOK, the telephone inventor and manufacturer, of Chicago, has been inventing in other fields besides telephony, having just sold a patent on a freight car door hanger to the Allith Manufacturing Company, of Chicago, for a neat little sum.

CORNELL APPOINTMENTS.—Mr. G. S. Macomber has been appointed assistant professor of electrical engineering at Cornell University. Other appointments at Cornell are: A. M. Buck, Jr., instructor in electrical engineering; H. H. Cochrane, instructor in experimental electrical engineering, and R. S. Pattison, instructor in physics.

MR. W. A. BLANCK announces that he has opened an office as consulting electrical engineer in Chicago, at 1200 Fisher Building. M. Blanck has been prominently identified with high-tension electric railway work for several years, and has taken a very active interest in electrical engineering matters in Chicago. For the past year he has been electrical engineer of the Chicago & Milwaukee Electric Railroad Company, in charge of electrical operation and construction of this road, which extends from Evanston to Waukegan, and is constructing from Waukegan to Kenosha near Chicago, in all about 70 miles. Mr. Blanck will still be connected in a consulting capacity with this company. For two years he was one of the engineers on the Arnold Company's staff and was the one who had particular charge of Mr. Bion J. Arnold's pioneer experiments at Lansing, on single-phase, high-tension trolley road, operating single-phase motors. Mr. Blanck is a German by birth, being educated at the Wriezen Gymnasium, and at Mittweida College in Saxony, from which latter he graduated as electrical and mechanical engineer. His engineering experience began in Germany, with Siemens & Halske. Later he was connected for six years with the Ganz Company, of Budapest, as engineer for high-tension lighting and power work. Immediately after coming to this country he was for a short time connected with the Chicago Edison Company. It will be seen that his experience is such as to fit him especially for high-tension electric railway work.

Trade Publications.

PORCELAIN SPECIALTIES.—Pass & Seymour, in their latest circulars, illustrate and describe their fuseless cleat rosettes and porcelain fixture sockets for damp locations.

TELEPHONE CONSTRUCTION WORK.—The F. Bissell Company, Cleveland, Ohio, has issued catalogue No. 125, covering a group of devices for telephone construction work of a thoroughly practical character and sold at moderate prices.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., is sending out some very interesting reading matter in the form of specifications and records. The specifications cover motor starting panels and motor speed controlling panels. The records show a comparison and record of results accomplished by Ward Leonard types of resistances and protective features, from 1892 to 1905. They contain good cuts and are gotten up in good form for reference files.

MACHINISTS' TOOLS.—In a handsome bulletin, recently issued, the Brown & Sharpe Manufacturing Company, Providence, R. I., describes micrometer caliper sets, steel beam trammels, universal dividers, scribers and straight edges. The chief characteristic of these tools is their accuracy.

WESTINGHOUSE PORTABLE INSTRUMENTS.—Circular No. 1104 of the Westinghouse Electric & Manufacturing Company is devoted to the portable testing instruments which have been designed particularly for field service. The instruments include voltmeters, ammeters, power factor meters, milli-ammeters, lamp testers, volt-wattmeter, polyphase and single-phase wattmeters. These instruments possess long scales and long working ranges, and are stated to be sufficiently accurate for all commercial work. The bulletin describes the details of construction of each instrument, the principles of its operation, and the methods and means for recalibration.

DIRECT-CURRENT MULTIPLE ARC LAMPS.—An arc lamp of pleasing appearance, which has been designed for both indoor and outdoor service, is described in detail in circular No. 1102, recently issued by the Westinghouse Electric & Manufacturing Company. Pains have been taken to prevent the sticking of the carbons. The lamp is of the direct-lift type, the pull of the magnets being directly upward, and the parts are so arranged as to secure a uniformly even action over the entire lift. It is supplied with a dash-pot of the vacuum type. The construction throughout is such as to make the lamp fireproof, and thereby to insure immunity from damage caused by abnormal currents or short circuits.

LIFTING MAGNETS.—The Electric Controller & Supply Company, Cleveland, Ohio, has issued a well-illustrated bulletin devoted to lifting magnets for handling iron material in any shape by means of cranes of any type. The case of each magnet consists of a heavy casting made from such a grade of steel that when the circuit of the energizing coil is opened the magnet drops its load instantly. The energizing coil is heavily insulated and treated by a vacuum-impregnating process which insures it against grounding or short circuiting. The magnet is moisture proof, and so heavily constructed that it cannot be injured by rough usage. Current is led to the coil through a heavily-guarded plug connection. These magnets are designed for lifting as much as 1,400 pounds of pig iron per lift, or as much as 11,000 pounds of iron in a single solid mass.

BELTED-TYPE, ROTATING-FIELD ALTERNATORS.—In Circular No. 1113, the Westinghouse Electric & Manufacturing Company describes a line of small-capacity alternating-current generators which are built for single, two or three-phase circuits. The single-phase generators have compensating field windings which are supplied with rectified alternating current obtained from the secondary of a series-wound transformer whose primary is in the armature circuit. The revolving field structure for machines of sizes below and including 75 kw. is of cast steel, with pole caps of the same material. In the larger sizes up to and including 200 kw., the poles are laminated. The field coils are composed of square wire and are held in place by means of heavy brass wedges, which, furthermore, act as dampers to retard the shifting of the field between the poles. These machines are built for both 25 and 60 cycles, in sizes varying from 30 to 200 kw.

OIL CIRCUIT-BREAKERS.—The Hartman Circuit-Breaker Company, Mansfield, Ohio, has recently issued a well-illustrated bulletin devoted to oil switches and circuit-breakers. An interesting feature in the construction of the oil switches resides in the use of moulded indurated fibre for certain parts where metal had formerly been used. This fibre, after being moulded and pressed to the desired shape, is treated by a special process which gives to it insulating qualities claimed to be substantially equal to porcelain. The oil tank of the Hartman switch is made exclusively of the moulded fibre, and requires no lining. Its weight is only a fraction of that of a metal tank, and, at the same time, it possesses greater strength and durability. The overload tripping coils of the circuit-brakers are operated directly from the high-potential circuit without the intervention of current transformers. The constructive features of the switches and breakers are described in detail in the bulletin, which contains a price list of these devices for potentials up to 22,000 volts.

AIR AND GAS COMPRESSORS.—A 175-page book, describing and illustrating a complete line of steam, electric, gas and power-driven compressors of all types, including single and duplex and simple and compound; single and multistage, etc., is being distributed by the Laidlaw-Dunn-Gordon Co., 114 Liberty St., New York City. It gives the results of the latest investigations upon air-valve gears (the most critical feature of an air compressor) and shows a gear combining the quietness, efficiency and high-speed qualities of mechanically-moved valves with the elasticity of poppet valves. It also explains the air lift for raising water from driven or bored wells, gives the amount of air required for pumps and drills, tells how to calculate pipe lines for compressed air, explains the effects of altitude and temperature, discusses the advantages of compounding and intercooling, the advantages of different valve gears for different purposes, the several methods of driving, and gives data on a hundred other things of use and interest to every actual or prospective user of compressed air. The book is a valuable addition to any technical library.

News of the Trade.

THE MANUFACTURERS' AGENTS' ASSOCIATION, of Los Angeles, Cal., has moved to its new offices in the Pacific Electric Building, in that city.

THE TRUMBULL ELECTRIC COMPANY, of Plainville, Conn., manufacturer of electrical supplies, has awarded the contract for the construction of a new factory building. The structure will be 40x106 feet, of brick, and a boiler house, 30x40 feet, will also be erected.

THE TIPLESS LAMP CO., New York, has removed to its new and complete factory and show rooms at 256 West Twenty-third St. The new factory has the advantage of a ground floor show room facing Twenty-third St., and is equipped with new and special machinery for the manufacture of the well-known Jaeger specialties.

THE JOHNS-PRATT COMPANY, of Hartford, Conn., is notifying the trade that imitations are being placed on the market of its well-known product Vulcabeston. It is almost needless to speak of the excellent standard that Vulcabeston has reached as an insulation, since it was introduced in 1886. Its use is now general. The H. W. Johns-Manville Company, New York, is the selling agent, and it has branches in almost every large city.

STAR ELECTRIC COMPANY.—A. B. Clapp, of Brattleboro, has associated himself with his nephew, B. C. Starr, and leased the store at 208 Worthington Street, in Springfield, Mass., where they opened on June 1 with a complete line of electrical and gas fixtures. An expert electrician from New York has been engaged and the firm expects to be able to do electrical contracting. The firm name will be the Starr Electric Company.

INTER-POLE MOTOR EXHIBIT.—The Electro-Dynamic Company will have an exhibit on the veranda of the Manhattan Beach Hotel, during the Master Mechanics and Master Car Builders' Convention, to be held at Manhattan Beach, L. I., N. Y., June 14 to 21. The exhibit will consist of one type "5-2" four-to-one Inter-Pole variable speed motor belted to a generator. This motor will also be reversed under all of the above conditions of load and speed. There will also be on exhibition different sizes of motors running from one horse-power at a speed ratio of four-to-one up to ten horse-power at a speed ratio of four-to-one. The motors which will be exhibited will cover 123 distinct varieties. The Electro-Dynamic Company is rapidly enlarging its scope of operation for the Inter-Pole motor and will within the next 90 days be prepared to offer at least 200 varieties of constant and variable speed motors running up as high as 150 horse-power. In addition to this exhibit a "5-2" variable-speed motor having a speed ratio of four-to-one will operate the electric car lighting equipment of the Consolidated Railway Electric Lighting & Equipment Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 30, 1905.
[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

790,883. ELECTRIC FUSE OR CUT-OUT; L. B. Buchanan, Woburn, Mass. App. filed Mar. 20, 1905. Is designed to improve the contacts of an electric fuse or cut-out, and for this purpose includes a pair of spring clips which embrace the usual plate connections of the fuse and cause them to bind the fuse connections more firmly.

790,886. INSULATED RAIL JOINT; S. S. Deemer, Reading, Pa. App. filed Aug. 15, 1904. The rails have blocks at the desired joint, giving the rail at the joints a rectilinear section. The fish plates are bolted to a base so as to form two sides of a containing box which contains the joint, and is insulated therefrom.

790,931. TROLLEY CATCHER; Lucean B. Stanley, Collinwood, Ohio. App. filed July 22, 1904. The trolley cord passes over a swinging arm which deflects the cord from a right line. A sudden movement of the trolley pole swings the arm upward and releases a pawl which permits the rewinding main spring to act.

790,939. SWITCH OPERATING MECHANISM; James C. Waldo, Sharpsburg, and John J. Forster, Avalon, Pa. App. filed Jan. 7, 1905. A power solenoid acts upon a core to which a swinging hook is attached. Motion of the core engages the hook with one or another of parallel swinging arms which throw the switch-point into its two positions alternately.

790,940. ADJUSTABLE SUSPENDING DEVICE FOR ELECTRIC LIGHTS; Arthur B. Wass and William Whitaker, Jr., Oakville, Canada. App. filed July 14, 1904. The flexible lamp cord is passed around a spring drum having a pair of contact rings for making the electrical connections. The drum is caught in any desired position by the usual form of curtain-roller catch.

790,941. ELECTRIC POWER SYSTEM; James E. Weaver, Allegheny, Pa. App. filed Apr. 27, 1904. An electrically operated fire engine in which a pair of motors are both mechanically geared to the pump and adapted to be plugged into a line circuit. The motors are connected in a special way so that they may be first run in series, then one of them separately, and finally both in parallel. An electric heater is provided for warming the pump in cold weather.

790,942. ELECTRIC POWER SYSTEM; James E. Weaver, Allegheny, Pa. App. filed Oct. 21, 1904. Relates to modifications of the above and particularly in the armature windings and connections. In this form one of the motor armatures has two separate windings, one for 333 volts and the other for 167 volts. The other motor operates on 500 volts. This arrangement virtually provides three motors whose working potential is as 1:2:3. The controller connects them up in various ways to provide wide changes of speed and load, and to secure an efficient starting arrangement.

790,945. TELEPHONE TRANSMITTER; Walter L. Wilhelm, Buffalo, N. Y. App. filed Mar. 4, 1902.

790,952. TELEPHONE MOUTHPIECE PROTECTOR; Joseph Maxwell Carrare, Allentown, Pa. App. filed Sept. 12, 1904.

790,957. INSULATING SUPPORT FOR THIRD RAILS; Ed W. Farnham, Chicago, Ill. App. filed June 27, 1904. The rail is supported by suitable fixtures upon its lateral face, also supporting a board above the rail to constitute a guard. The supports have conical insulating caps which engage corresponding recesses in the fixtures.

790,966. INDICATOR FOR SIGNAL TRANSMITTERS; George William Lorimer, Piqua, Ohio. App. filed July 22, 1902.

790,975. ELECTRIC SPARK GAP OR INTERRUPTER; Earle L. Ovington, Boston, Mass. App. filed Feb. 11, 1905. In series with the usual spark-gap is an auxiliary gap between mercury electrodes in vacuuo.

790,983. SWITCH FOR ELECTRIC CIRCUITS; Benjamin P. Rucker, Wilkinsburg, Pa. App. filed Oct. 8, 1904. Circuits are provided for operating the switch from a distant point. The circuits are arranged to initially short circuit the field coils through a resistance, and then open the main switch.

791,003. RAILWAY BLOCK SIGNAL SYSTEM; Frank E. Button, New York, N. Y. App. filed Aug. 12, 1904. Relates to block signal systems for railways, the object of the same being to provide means whereby a signal will be automatically given upon a train or car which will indicate the presence of another train or car in the same block, in the block ahead, or in the block behind, no matter in which direction the train may be moving. A source of constant electric current is provided for each block, and a conductor leads from each source of current along and parallel with the trackway for a distance of two blocks in one direction. Within the train, and preferably in both the locomotive and the caboose thereof, are a plurality of lamps, and contacts upon the trains include said lamps in the circuits of the said conductors so that the lamps display the condition of the track.

791,008. SNAP SWITCH; Walter A. Church, Binghamton, N. Y. App. filed Oct. 18, 1902. The switch plate has a spring connection with the key, and a cam is arranged to move longitudinally of the spindle to release the spring suddenly, so that the switch plate may snap to its other position.

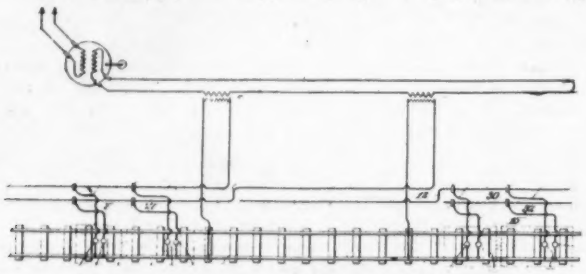
791,012. STRAIN DEVICE FOR ELECTRIC RAILWAYS; Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Oct. 19, 1904. The trolley conductor is supported from suspension or messenger cables which are in turn held by diagonal strain cables secured to the usual poles. Supports are placed adjacent to the track to steady the trolley conductor against lateral vibration.

791,013. SUPPORTING AND STRAIN DEVICE FOR ELECTRIC RAILWAYS. Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Jan. 23, 1905. Designed particularly for high-speed electric railways where a perfectly straight and stiff trolley conductor is essential. The trolley conductor is supported by a combination of cables and suitable fixtures which virtually form a suspension bridge for the trolley conductor.

791,021. TRANSFORMER; Charles LeG. Fortescue, Wilkinsburg, Pa. App. filed Sept. 30, 1903. A transformer core in which the laminations are formed of E-shape, and arranged to be dove-tailed into closed magnetic circuit by small rectilinear sections.

791,025. APPARATUS FOR MOVING SWITCH RAILS; Marquis D. Hanlon, Wilkinsburg, Pa. App. filed Feb. 17, 1905. Provides a pair of detector bars, one adjacent to each of opposed track switches. The detector bars are so connected that both are moved when either switch motor is operated.

791,031. SUPPORTING STRUCTURE FOR TROLLEY WIRES; Budd J. Jones, Chicago, Ill. App. filed Apr. 2, 1904. The trolley is supported from a catenary suspension or messenger wire, and lateral supports engage the trolley conductor at proper intervals so as to prevent vibration thereof.



791,003.—Railway Block Signal System.

791,079. RAIL CLIP FOR THIRD RAIL INSULATORS; George L. Courtenay and William Courtenay, New York, N. Y. App. filed Aug. 27, 1904. The third rail has a depending rib to which is secured a pair of lugs adapted to clamp between them insulating blocks. Each block is supported by a base having lateral arms.

791,081. TAPING MACHINE; Albert G. Davis, Schenectady, N. Y. App. filed Jan. 13, 1902. The transformer coils are laid upon a flat table having ball bearing supports of the form employed for ball-bearing casters. In this way the coil may be moved readily over the table into the proper position for manipulation.

791,082. TROLLEY WIRE HANGER; Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Oct. 19, 1904. Relates to the fixtures by which the trolley conductor is supported from a catenary messenger cable at suitable intervals.

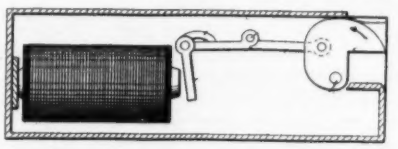
791,083. CURVE PULL-OFF FOR OVERHEAD TROLLEY CONDUCTORS. Harry P. Davis and Theodore Varney, Pittsburg, Pa. App. filed Oct. 19, 1904. Relates to modifications of the above, and is particularliy designed for supporting the trolley at curves. It has diagonal connecting rods to hold the trolley hangers upright.

791,085. THUMB PIECE FOR ELECTRICAL SWITCHES; Frank C. DeReamer, Schenectady, N. Y. App. filed Dec. 9, 1902. Details of construction of an electric switch in which the cover is maintained in position against the base by a spring on the spindle.

791,095. CARBON BREAK FIELD SWITCH; Edward M. Hewlett, Schenectady, N. Y. App. filed July 29, 1903. The terminals of the generator are connected to the blades of the switch lever which can move into two positions to make connection with separate bus bars. At an intermediate position the generator is short-circuited through a resistance by carbon contacts on the switch lever.

791,103. TELEGRAPH KEY AND SWITCH; Thomas J. McAdams, Annapolis, Mo. App. filed May 19, 1904. Relates to details of a switch having various line connections any of which can be independently used.

791,113. ELECTRIC DOOR OPENING DEVICE; Frank Staehle, Newark, N. J. App. filed Feb. 10, 1904. A form of electric controllable door latch in which the latch proper is a pivoted part normally held in locking relation by toggle links which normally lie in a straight line. A magnet is arranged to destroy the alignment whereupon the links do not exert any further locking action.



791,113.—Electric Door Opening Device.

791,114. ELECTRIC SIGNALLING INDICATOR; William Starkey, Chicago, Ill. App. filed Feb. 6, 1905. The register is adapted to be stepped around by a pawl and ratchet controlled from a solenoid magnet. The different register magnets are connected in a circuit whereby the indicators move synchronously.

791,116. CONTROL OF SYNCHRONOUS MACHINES; John B. Taylor, Schenectady, N. Y. App. filed Oct. 17, 1904. The main switch for an alternating current generator can only be operated through a small motor in a local circuit which includes the synchronizer for that generator, so that the synchronizer must be operated before the switch can be thrown.

791,124. CONTROLLER FOR ELECTRIC MOTORS; George Baehr, McKeesport, Pa. App. filed Feb. 10, 1905. The controller arm has its movement limited by an adjustable stop.

791,152. ELECTRIC LAMP; Richard Küch, Hanau, Germany. App. filed Mar. 3, 1904. (See Current News and Notes.)

791,178. TROLLEY WIRE SWITCH; Joseph T. Bunn, Washington, D. C. App. filed Aug. 3, 1904. The trolley harp has a pair of rolls in slightly staggered relation pivoted thereon, and a plate having grooved tracks is made part of the hanger at the intersection so that the trolley is guided by the small rolls and the grooved tracks at the instant of crossing the intersection.

791,180. ELECTRIC MOTOR FOR AUTOMOBILE VEHICLES; Eugenio Cantono, Rome, Italy. App. filed Aug. 11, 1902. The steering gear of the motor vehicle includes a contact arm which varies the electromotive force of the respective motors on the rear axle when rounding a curve.

791,182. THERMOSTATIC CIRCUIT CLOSER; Albert D. Caywood, Chicago, Ill. App. filed Aug. 12, 1904. A notched contact plate of the thermostat is normally spring-pressed rotarily and also outward. When the soldered cap is melted off, the contact plate moves outward and makes contact.

791,191. TROLLEY GUARD; Mathias Hartz, Pittsburg, Pa. App. filed Feb. 27, 1904. The trolley harp has swinging arms thereon between which is pivoted a horizontal drum and a pair of inclined guide wheels, all of which co-operate to hold the wheel upon the conductor.

791,220. MEANS FOR PROTECTING BOOSTER SETS; Frank L. Sessions, Oak Park, Ill. App. filed Dec. 18, 1899. The usual magnetic cut-out in series with the line current has a small magnet in the shunt field of the booster motor, which will also trip the cut-out.

791,228. ELECTRIC RAILWAY SIGNAL OR ALARM; Earl L. Tatum, Washington, D. C., and James W. Tatum, Durham, N. C. App. filed Sept. 2, 1904. A conductor is provided in proximity to the tracks and forms part of a circuit, including resistance measuring devices on two trains and the intermediate track section. The measured resistance indicates the distance apart of the trains.

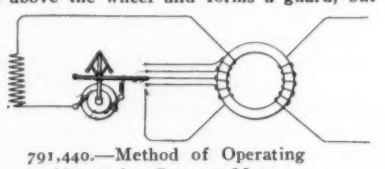
791,232. APPARATUS FOR TREATING RHEUMATIC OR OTHER DISEASES; Casimir Wolpers and Thomas F. Barrett, Chicago, Ill. App. filed Oct. 6, 1904. A housing contains a bank of incandescent lamps and circuits are provided for switching on different groups for different medical treatments.

791,233. METHOD OF TREATING RHEUMATIC OR OTHER DISEASES. Casimir Wolpers, Chicago, Ill. App. filed Oct. 6, 1904. Relates to changes in the above and particularly the manner in which the patient is exposed to violet and then blue rays successively.

791,253. REGULATING MEANS FOR ELECTRIC LAMPS; Albert G. Davis, Schenectady, N. Y. App. filed Sept. 18, 1902. (See Current News and Notes.)

791,277. RINGING GENERATOR; John C. F. Malthaner, Minneapolis, Minn. App. filed July 20, 1904.

791,279. TROLLEY; George V. Miller, Irwin, Pa. App. filed Apr. 7, 1905. The trolley harp supports a swinging bearing for the trolley wheel proper and a disk having hooks thereon is revolvably supported by the bearing. Normally the disk lies above the wheel and forms a guard, but in passing an obstruction it swings down and the hooks are rotated one quarter turn by the wire. This has the effect of passing the disk below the wire so that the obstruction can be passed.



791,440.—Method of Operating Alternating-Current Motors.

791,289. COMBINED MANHOLE AND JUNCTION BOX; Lyman C. Reed and Alexander H. McComiskey, New Orleans, La. App. filed Sept. 19, 1904. The manhole box has an outside annular portion which is removable separately from the center cover. In this way the electrical connections can be exposed without the annoyance of the sewer gas.

791,310. STATIONARY PLATE FOR STATIC MACHINES; Burton E. Baker, Hartford, Conn. App. filed Dec. 31, 1904. The armatures of the stationary plate of a static machine are embedded in a plate of paper, linen and shellac, so that they are protected from the dust and damp.

791,335. ELECTRICAL APPLIANCE FOR THE FEET; Eusebio Fernandez y Moreno, Madrid, Spain. App. filed Oct. 25, 1904. The sole of the shoe has contacts which form the terminals of a voltaic pile.

791,349. BURGLAR ALARM HOUSE PROTECTOR; Joseph Lyon, Dayton, Ohio. App. filed Aug. 14, 1901. A burglar alarm so arranged that it is actuated by an initial movement of the lock when the same is tampered with.

791,376. ILLUMINATING POLICEMAN'S BILLY; George Ranlett Somes, Laconia, N. H. App. filed Jan. 28, 1904. The butt end of a policeman's club has a glow lamp therein so that the officer can conveniently discover evil-doers.

791,413. TELEGRAPHIC TRANSMITTER; Alfred C. Gilmore, Chicago, Ill. App. filed Jan. 29, 1902. A typewriter designed to transmit Morse code signals. A power driven shaft has contact plates for each character and is released by a universal bar. Each character engages a spring blade with proper contacts to transmit dots and dashes for that letter.

791,423. ALTERNATING CURRENT ELECTROMAGNET; John D. Ihlder, New York, N. Y. App. filed Dec. 2, 1904. Two separate magnets in separate circuits aggregated together.

791,429. ELECRIC BLOCK SIGNALLING SYSTEM; William M. Murphy, New York, N. Y. App. filed Aug. 31, 1904. Involves the use of the power current. One rail is at high potential and the other rail is divided into sections. Local circuit relays between the high potential rail and the respective section of the second rail actuate the semaphore signals when short circuited by a train.

791,435. ELECTRIC SPEED LIMITING DEVICE; Bertus G. Barlow, Manchester, N. H. App. filed Dec. 9, 1904. Centrifugal weights are fastened to spring arms which move along a sliding collar to make or break the motor circuit.

791,440. METHOD OF OPERATING ALTERNATING CURRENT MOTORS; Alexander Churchward, New York, N. Y. App. filed Oct. 31, 1903. A device by which motors of the general direct current type can be operated efficiently by an alternating current. The armature rotations should synchronize with the periodicity so that the armature virtually forms a rotor. A speed governor cuts coils in and out of the current-supplying transformer, so that the speed of the motor is maintained at this proper synchronizing amount.